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Engineering and Mining Journal

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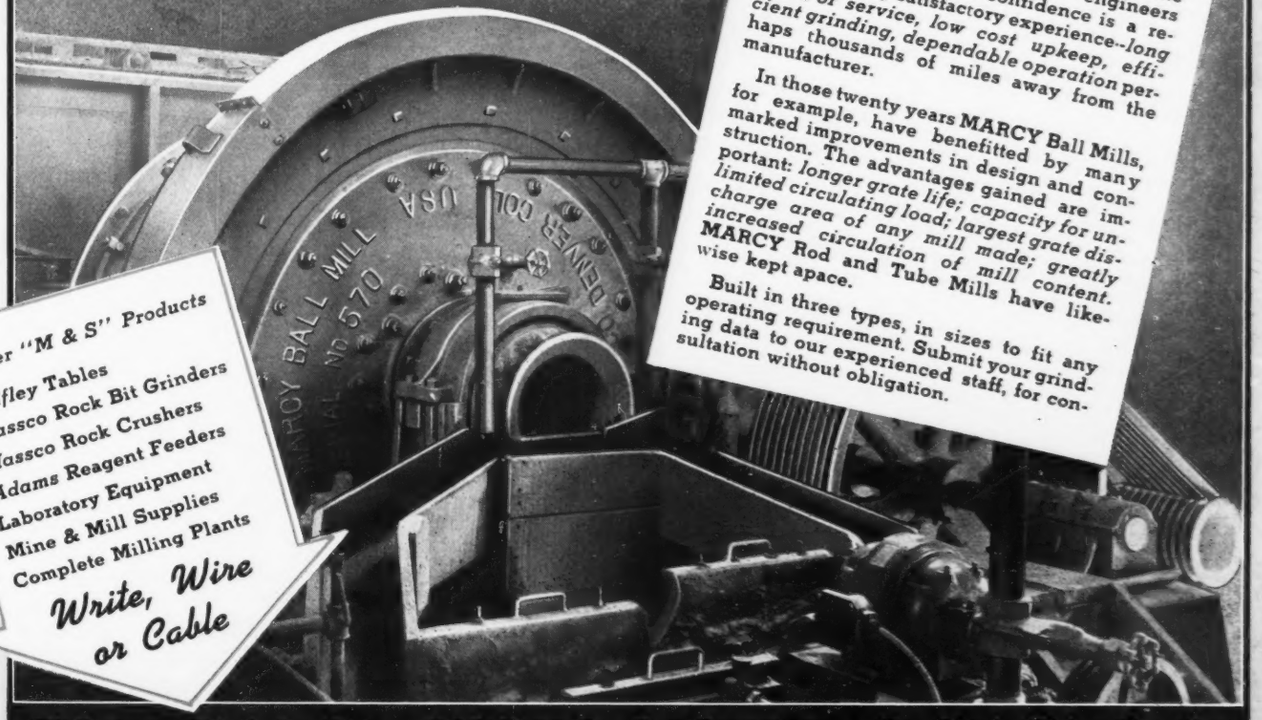

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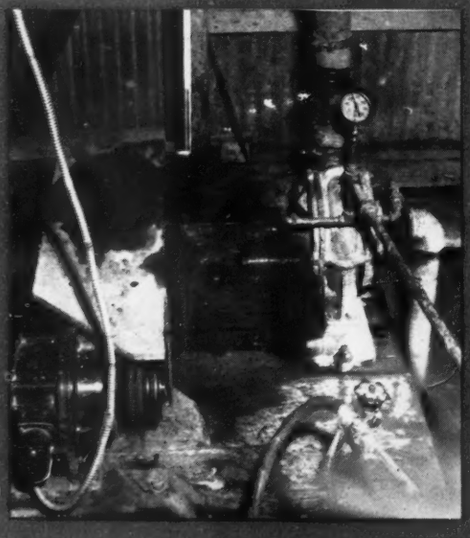

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Unique among mining operations in the Birmingham district of Alabama is that of the Tennessee Coal, Iron & Railroad Company in its limestone mine, Muscoda No. 5. The bed worked for the flux used in the company's furnaces lies 300 ft. above and parallel to the Big Seam of iron ore that dips into Red Mountain and is the source of the district's iron. Limestone mined is dropped to the iron workings below and hoisted to surface through No. 5 slope. The work will be described in an early issue.

▼

Rock Crushing has recently been studied at Moscow, Idaho, with particular reference to velocity of hit. The velocity factor is of importance, as it was found to affect both the size distribution of the crushed product and the efficiency of crushing. A. W. Fahrenwald, Joseph Newton, and Earl Herkenhoff, in a jointly-written article, will discuss the subject soon.

▼

"Core" Samples of the ocean bottom have been taken at depths of three land miles with special apparatus on the end of a sounding line. Essentially this consists of a steel tube which on reaching bottom is forced into the sediment by an explosion of cannon powder contained in a "gun" attached to its upper end. "Cores" up to 10 ft. long were taken last year between the Grand Banks of Newfoundland and the Continental shelf west of the Irish coast. The samples are of interest to many investigators. C. S. Piggot describes the work in the 1936 Report of the Smithsonian Institution.

▼

The Smithsonian presents with its report the usual fascinating miscellany of articles. The topics range from ultraviolet radiation to drift and rhythm of the continents; from astronomy in Shakespeare's time to sunspots and northern lights; from evolution to the history of the crossbow; and from aboriginal rock carvings in the United States to gorillas in Uganda. Here is a great deal of worthwhile reading for a dollar and a half, this in its way bearing out the Institution's motto—"For the increase and diffusion of knowledge among men."

"Vertical Climate," a phrase coined for climates exhibiting extreme variations, applies very well to the climate of Central America, according to R. W. Prouty, in an article that is soon to appear, describing economic, geological, and political conditions in this group of republics between the Caribbean and the Pacific. Mining men unfamiliar with these countries will find the information given by Mr. Prouty useful, should their work take them to this part of the world. The article is based on some recent experiences of the author in the regions mentioned.

H. C. PARMELEE
Editorial Director

Engineering and Mining Journal

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Manager

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MACHINES THAT NEED RUBBER HEELS

A typical example of Goodrich development in rubber

THIS is the way machines used to look in an Ohio manufacturing plant. The huge press vibrated, and transmitted so much of its vibration to the floor that delicate grinding machines nearby were affected—every time the press plunged down, the grinders jumped so that their product could not be made to the .0006-inch tolerance required. Everything was tried—even a special individual foundation for the press—but vibration still continued.

A Goodrich engineer had discovered a way to bond rubber inseparably to metal. Strengthening that bond to bear the weight of heavy industrial machinery made possible the "Vibro-Insulator"—and shock and noise in industry were defeated.

Goodrich Vibro-Insulators are literally rubber feet for anything which vibrates. They consist of two pieces of metal—one attached to the machine, one to the floor—bonded together with rubber so that the machine virtually hangs in the air, partly suspended and partly resting on the rubber, which absorbs the vibration and so kills the shock and noise.

The manufacturer equipped his grinders with these Vibro-Insulators—and rejects were reduced to the vanishing point.

Hundreds of concerns have used this Goodrich development to increase accuracy of product, improve efficiency of workers, lengthen life of machines. But the important point—important to every plant in every industry—is that this development is typical of the constant research going on at Goodrich—research which develops new rubber compounds and new uses for them, to make every Goodrich product the best value money can buy. The B. F. Goodrich Company, Mechanical Rubber Goods Division, Akron, Ohio.

Goodrich

ALL *products problems* **IN RUBBER**

(Another story on Goodrich development work appears on page opposite third cover)

Engineering and Mining Journal

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Volume 138 Number 11

NOVEMBER 1937

The Photograph Racket

SEVERAL MINING ENGINEERS have notified us recently that they have been solicited by telephone to have their photographs taken, ostensibly for *Engineering and Mining Journal*. Such solicitations are made without our authority. We deplore the practice, disclaim any part in it, and make every effort to stop it. We ask mining men not to be misled by such representations, and to notify us if they are thus solicited. We do not customarily obtain photographs in this manner. Occasionally we engage photographers to obtain pictures for us, but only on written authorization after arrangements have been made with the individual or company concerned.

Engineering Curricula Accredited By Engineers' Council

FOR THE FIRST TIME in the history of engineering education in the United States, engineering curricula throughout the country have been appraised by a representative body of engineers, and a single accredited list has been published of courses of study deemed worthy of approval. The accrediting process has been carried out during the past two years by the Engineers' Council for Professional Development, a joint organization created by seven national engineering societies for the purpose of enhancing the status of the engineering profession. The American Institute of Mining and Metallurgical Engineers is one of the participating bodies.

Working through four major committees, the Council inaugurated five years ago a program dealing with the selection, guidance, training, and recognition of members of the engineering profession. The objective of the Committee on Engineering Schools was "to formulate criteria for colleges of engineering, which will insure to their graduates a sound educational background for practicing the engineering profession," and to give recognition to those institutions prepared to teach engineering according to acceptable standards. Accrediting was based on both qualitative and quantitative criteria, and the procedure involved the use of an extensive questionnaire, examination of catalogs, and a personal inspection of each institution by a committee of engineers. Participation of the educational institutions was voluntary, and inspection was made only at their invitation.

Announcement of the accredited list was made at the fifth annual meeting of E.C.P.D. on October 1, 1937. At that date 107 engineering schools had been visited and 445 curricula accredited in 16 branches of engineering. Committees of inspection throughout the country numbered 102 engineers.

Of particular interest to the mining industry are the curricula accredited in mining and metallurgical engineering. These will be found on page 78 of this issue. The list does not include several schools that have applied for accrediting with the request that inspection be made in 1937–38. But more than threescore schools of mines have successfully passed the rigid appraisal of competent engineers, and are regarded as qualified to teach mining and metallurgical engineering according to acceptable standards. Scattered through 22 States, these schools afford a wide range of choice to prospective students, who may make their selections with confidence that adequate facilities for instruction are available. *Engineering and Mining Journal* congratulates the mining educators throughout the country who have made such an excellent showing in the accrediting program.

American Engineers Out of Russia

REVIEWING THE RESULTS of two historic five-year plans of the Soviet Union, we believe that American mining engineers in that country have achieved a measure of unrecognized success under what is, perhaps, the most puzzling set of economic, political, and psychological circumstances in history. Only one who has had recent experience in the U.S.S.R., or who has enjoyed the confidence of

returning American engineers, can realize the difficult conditions under which such men have had to work. Increasingly hampered by political red tape and internal jealousy and fear, they have found it more agreeable to leave the country.

By their own testimony they were confronted with unreasonable delays and opposition, engendered mainly by the Russian's fear of assuming responsibility and making honest mistakes. This resulted in interminable discussions, much "passing the buck," and loss of time. Attempts to cut through the red tape were met with "You Americans don't understand the Russian and his system of government." Strong representations to Moscow, translated by apprehensive interpreters, netted little support in the field. It is not difficult to understand how irksome such conditions were to American engineers of characteristic initiative and aggressiveness.

Still another factor contributed to Americans' discomfort and discouragement—a growing cleavage between the young, inexperienced Russian engineers and their older, experienced countrymen. The former, usually members or prospective members of the Communist party, were enthusiastically loyal to Moscow's wishes, and saw no reason why production plans could not be fulfilled. The latter, usually not party members, honestly doubted their ability to meet production demands. In self-protection the younger group were disposed to denounce the older conservatives as saboteurs and spies. Nor were American engineers spared from secret police surveillance if their honest professional opinions were contrary to the realization of planned production. Small wonder that under such conditions they preferred a healthier atmosphere not surcharged with fear and suspicion.

Invention and Employment

THE PROGRESS OF INVENTION, so far as its capacity to provide new employment is concerned, is like the production of an oil pool that, when first tapped, gives oil under pressure in great abundance, then less and less until pumping and forced recovery methods are necessary, and finally ceases to yield at all, unless one dig down to it. For ages secrets now revealed lay hid, although the revelation was just "around the corner." Not until men began to see the true nature of matter and the forces in the world about them did they make progress in material ways, and then they rapidly advanced. Discovery followed disclosure, seemingly unending, the inventions giving rise to plentiful employment. But in the assumption that this is to be unending lies difficulty.

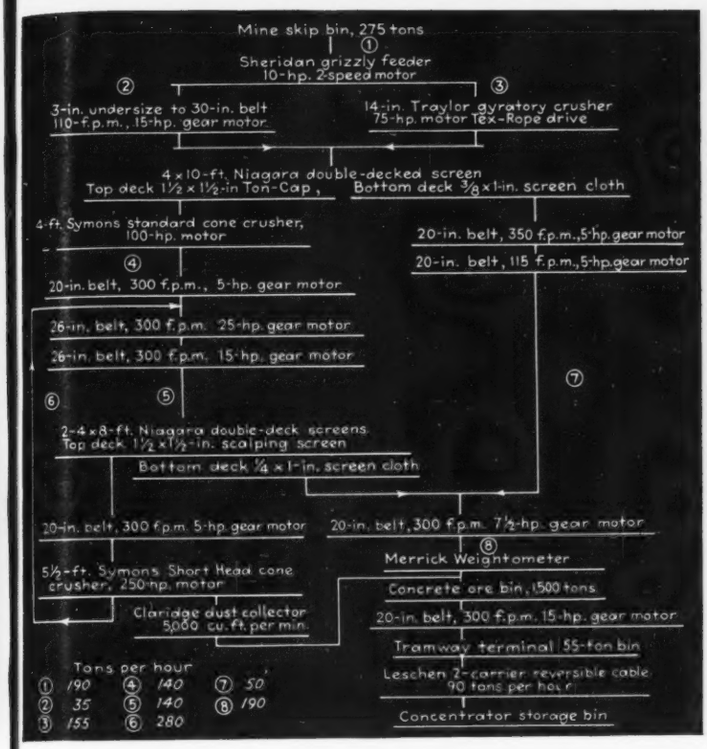
Despite predictions to the contrary, too many people still say smoothly there will always be sufficient new invention to keep everyone employed. Although discovery in an infinite universe will probably be unending, the great outpouring of employment-giving invention the world has witnessed suggests the flush production of the pool described, coming in huge volume because so much has been long pent up, but not to last forever in such generous proportions. It seems bound to taper off. Even now, current invention seems more and more to supply products that merely displace other products, in respect to utilization. Means for meeting basic needs, wherein the bulk of mankind finds employment, have already been well devised, although they must be more extensively applied. The future calls for wiser measures than that of perhaps fruitlessly counting on new invention.

Increasing Importance of Non-Metallic Minerals

DEDICATION of the Eastern Experiment Station of the United States Bureau of Mines at College Park, Maryland, directs attention to the growing importance of non-metallic minerals in the national economy, and the necessity of improved technology in their preparation for market. Having recognized these facts for some time past, the Bureau took steps to provide adequate facilities for non-metallic mineral investigations in a new experiment station which has now been completed. It is appropriately located in the East, where deposits of non-metallics are abundant.

The incident has a fourfold significance for the mining industry. First, it portends an expanding field of activity for technically trained men. Second, it promises a wider application of equipment and methods developed primarily for the treatment of metallic ores. Third, it will result in the production of minerals that will meet the increasingly rigid specifications of consumers. And fourth, it will make available domestic sources of minerals some of which are now imported.

Trends in these directions have been evident in recent years. But the entry of the Bureau of Mines into the field of research and experimentation should result in more rapid progress toward a high plane of technology. Unsolved problems are still numerous. But they will be approached with scientific intelligence under experienced direction, to the ultimate benefit of the entire non-metallic mineral industry.


Mine skip bin, 275 tons
① Sheridan grizzly feeder 10-hp. 2-speed motor
② 3-in. undersize to 30-in. belt 110-f.p.m., 15-hp. gear motor
③ 14-in. Traylor gyratory crusher 75-hp. motor Tex-Rope drive
4 x 10-ft. Niagara double-decked screen Top deck 1½ x 1½-in Ton-Cap, Bottom deck ⅜ x 1-in. screen cloth
4-ft. Symons standard cone crusher, 100-hp. motor
④ 20-in. belt, 300 f.p.m., 5-hp. gear motor
20-in. belt, 350 f.p.m., 5-hp. gear motor
20-in. belt, 115 f.p.m., 5-hp. gear motor
26-in. belt, 300 f.p.m. 25-hp. gear motor
26-in. belt, 300 f.p.m. 15-hp. gear motor
⑦
⑥ ⑤
2-4 x 8-ft. Niagara double-deck screens Top deck 1½ x 1½-in. scalping screen
Bottom deck ¼ x 1-in. screen cloth
20-in. belt, 300 f.p.m. 5-hp. gear motor
20-in. belt, 300 f.p.m. 7½-hp. gear motor
⑧ Merrick Weightometer
5½-ft. Symons Short Head cone crusher, 250-hp. motor
Concrete ore bin, 1500 tons
Claridge dust collector 5,000 cu. ft. per min.
20-in. belt, 300 f.p.m. 15-hp. gear motor
Tramway terminal 55-ton bin
Leschen 2-carrier reversible cable 90 tons per hour
Concentrator storage bin
Tons per hour
① 190 ④ 140 ⑦ 50
② 35 ⑤ 140 ⑧ 190
③ 155 ⑥ 280

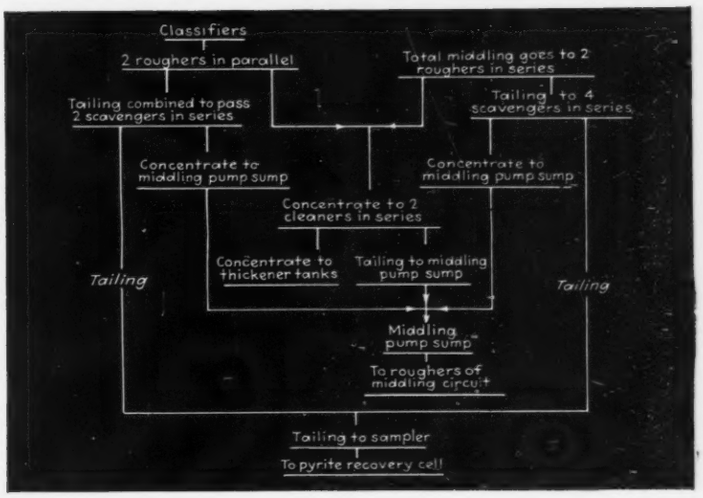

Classifiers
2 roughers in parallel
Total middling goes to 2 roughers in series
Tailing combined to pass 2 scavengers in series
Tailing to 4 scavengers in series
Concentrate to middling pump sump
Concentrate to middling pump sump
Concentrate to 2 cleaners in series
Concentrate to thickener tanks
Tailing to middling pump sump
Tailing
Tailing
Middling pump sump
To roughers of middling circuit
Tailing to sampler
To pyrite recovery cell

Fig. 1 (left) . . . CRUSHING in the new plant is done in a primary gyratory followed by Symons cone units with intermediate screening, as shown here. Capacity is 190 tons per hour

Fig. 2 (above) . . . FLOTATION PRACTICE at the Minas de Matahambre plant, in its several steps, is summarized in this diagram. The flowsheet given in Fig. 4 shows the individual units and their respective functions

Matahambre Improves Milling Practice

New crushing plant and simplifying of flotation by treating the middling separately give lower costs and better results

A. R. Kirchner
Mill Superintendent

A. C. Bean
Assistant Mill Superintendent

E. S. White
Crusher Plant Foreman

Minas de Matahambre, S. A.
Pinar del Rio, Cuba

VARIOUS improvements have been made in the milling practice followed at the concentrator of Minas de Matahambre, in Pinar del Rio, Cuba, since the publication by the United States Bureau of Mines, in November, 1931, of a paper[1] describing the work done there. These include:

1. Construction of an entirely new crushing plant, the flowsheet of which is shown in Fig. 1.
2. Change of the flowsheet of the flotation section as shown in Fig. 2.

A comparison of the metallurgical results and costs for the years 1930 and 1936 is given in Table I.

The concentrator treats by selective flotation the ore of the Minas de Matahambre. This ore consists of primary chalcopyrite, associated with pyrite and gangue minerals of shale and quartzite. The chalcopyrite occurs in masses, small veinlets, and stringers as a replacement more or less evenly distributed in a fracture zone in the shale and quartzite. Pyrite occurs in small veinlets and disseminated through chalcopyrite and shale.

Mill heads average 12.3 per cent chalcopyrite, 5.2 per cent pyrite, and 3.4 per cent moisture. Matahambre ore presents no especial difficulty in crushing after the wet, sticky material has bypassed the intermediate stage of crushing. Removal of these wet fines from the circuit at this point is important, inasmuch as it increases the plant capacity by at least 100 per cent.

No. 2 crusher plant was built at No. 2 Shaft. All ore is now hoisted here and crushed in the new plant. Mine skips discharge a minus-12-in. product into a 275-ton bin above the collar of the shaft. The ore is pulled from this bin by a 3x10-ft. Sheridan grizzly feeder, with 3x4-in. openings. Undersize is dropped onto a 30-in. conveyor belt, bypassing the primary crusher, the oversize passing to a 14-in. Traylor Bulldog gyratory which breaks to 3-in. size.

This product is passed over a 4x10-ft. standard Niagara double-deck screen. The top deck carries a 1½x1½-in. Ton-Cap and is used to save wear on the bottom deck, which is equipped with ⅜x1-in. screen cloth. The undersize, which contains 10 per cent moisture, is the wet, sticky material already mentioned. It is sent directly to the storage bin. The amount removed depends on the run of the mine and varies from 40 to 60 tons per hour. Oversize from primary screening passes to a 4-ft. Symons standard cone crusher, set to 1¼ in.

Two 4x8-ft. standard Niagara double-deck screens that operate in closed circuit with a 5½-ft. Symons Short-Head cone crusher receive the combined product of the 4-ft. and the 5½-ft. crushers. The top decks of these screens are equipped with

[1] Information Circular 6544: "Milling Methods and Costs of the Minas de Matahambre, S. A., Concentrator."

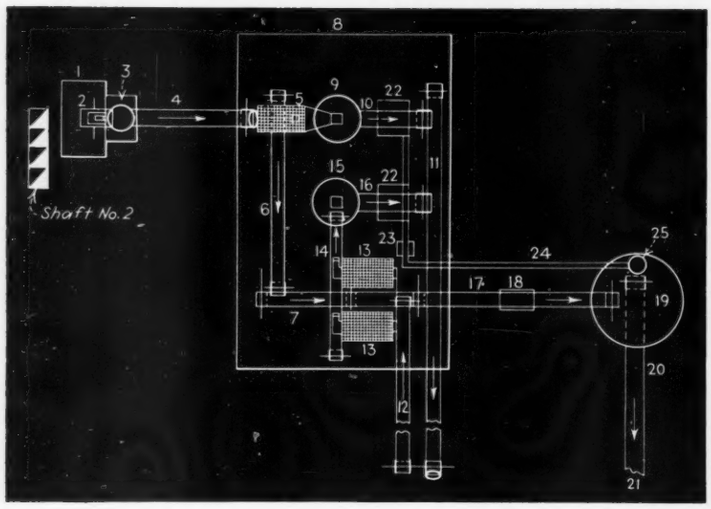


Fig. 3 . . . THE LAYOUT of the new crushing plant is presented. The numbers are explained in the accompanying legend

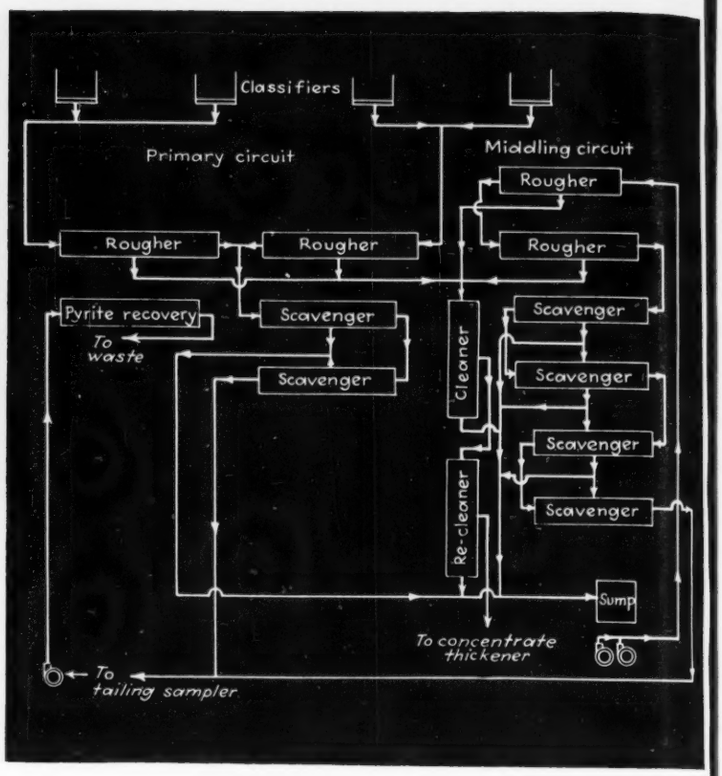


Fig. 4 . . . SELECTIVE FLOTATION of the chalcopyrite and pyrite has been simplified by treating the middling separately, as shown in this flowsheet. The middling is handled in a six-cell circuit, and the flotation feed in a circuit of four cells

LEGEND

1. Mine skip bin; total capacity, 275 tons
2. Sheridan grizzly feeder; 10-hp. 2 speed motor, 3-in. bypassed to No. 1 belt
3. 14-in. Traylor gyratory crusher; 75-hp. motor, Tex-Rope drive
4. 30-in. belt, No. 1; 100 f.p.m., 190 tons p.h., 15-hp. gear motor
5. Niagara 4x10-ft. double-decked screen, ⅜-in. bypassed to belt No. 1-A
6. 20-in. belt, 350 f.p.m., undersize from 10-ft. Niagara to belt No. 1-D
7. 20-in. belt, 115 f.p.m., undersize from belt No. 1-A to belt No. 7
8. Crushing and screening building
9. 4-ft. Symons standard cone crusher with 100-hp. motor.
10. 20-in. belt No. 2, 300 f.p.m., 5-hp. gear motor
11. 26-in. belt No. 3, 300 f.p.m., 25-hp. gear motor
12. 26-in.belt, No. 4, 300 f.p.m., 15-hp. gear motor
13. 2 4x8-ft. Niagara double-decked screens, +¾-in. to belt No. 5
    —¾-in. to belt No. 7
14. 20-in. belt, No. 5, 300 f.p.m.; 5-hp. motor, jack-knife support
15. 5½-ft. Symons Short-Head cone crusher, 250-hp. motor
16. 20-in. belt No. 6, 300 f.p.m., 5-hp. gear motor
17. 20-in. belt No. 7, 300 f.p.m., 7½-hp. gear motor
18. Merrick Weightometer
19. Concrete ore bin, capacity 1,500 tons
20. 20-in. belt, No. 9, 300 f.p.m., 15-hp. gear motor
21. Tramway loading terminal. Jig-back cable
22. Dust collector hoods or crusher
23. Claridge No. 35 exhauster fan, 5,000 cu. ft. per minute
24. Dust discharge duct to cyclone at bin
25. Cyclone dust collector

▼

1½x1½-in. scalping screen cloths. One of the bottom decks is provided with ¼x1-in. cloth and the other with ⅜x1-in. cloth. Oversize from the screens goes to the 5½-ft. Symons crusher, set to ⅜ in.

Undersize from the Niagara screens, as also the final product of the crusher plant, is weighed by a Merrick Weightometer as it is delivered to the storage bin. Hourly samples of the finished product are taken for determination of moisture.

Table V shows the undersize from the primary screen and the screen analysis of the combined undersize from screening as the finished product of the crusher plant.

The crusher plant has a capacity of 190 tons per hour. Production of the mine is hoisted and crushed on one 8-hour shift. Tonnages and costs of the various stages of the crusher plant are given approximately in Table VI.

A reversible Leschen tramway having two carrier cables delivers the ore to the concentrator. Each bucket has a capacity of 3 tons, and the tramway handles the ore at the rate of 90 tons per hour. This installation replaced an older one previously in operation. Tramway costs for the year 1936 of $0.018 per ton compare favorably with the costs of $0.036 obtained for the year 1930.

Concentration — Because of the subsequent freight and smelting expense, the highest grade of concentrate consistent with economical recovery is made. Prior to 1934, the flowsheet of the flotation section employed the conventional "middling-return-to-the-rougher" cells. The flotation section was divided into two sections in parallel, each section consisting of roughers followed by three scavengers in series. Concentrate from the roughers of both sections was combined and cleaned in two cleaners in series.

Investigations showed that the middling tonnage was from 90 to 110 per cent of the original feed to flotation. The layout of the two sections in parallel permitted the experiment of treating the middling in a circuit of six cells and the flotation feed in a circuit of four cells, leaving the two concentrate cleaners in series, with a minimum of expense and no loss of operating time.

As shown in Fig. 2, the product from the fine-grinding section is split between two roughers in parallel, the tailings from these combining to pass in series through two scavengers and thence to the tailing sampler.

The middling is collected in a sump and pumped to the head of two roughers which operate in series, the tailing from the second rougher passing in series through four scavengers before being combined with the tailing from the primary circuit and sampled.

Matahambre ore is treated in twelve pneumatic-type cells for recovery of the copper and in one cell of the same type for recovering the iron pyrite. The latter product

MINAS DE MATAHAMBRE surface plant, in Pinar del Rio, Cuba.

1. Shaft No. 3

2. Concentrator

Table I—Comparative Metallurgical Results and Costs, 1930 and 1936

Year	Dry Tons Milled	Per Cent Copper			Recovery	Cost per Ton Crushed	Cost per Ton Milled
		Heads	Concentrates	Tailings			
1930	359,468	4.55	29.20	0.216	96.00	$0.130	$0.617
1936	301,230	4.25	30.03	0.189	96.11	0.107	0.479

Table II—Product of Sheridan Grizzly and Primary Crusher

Size, In.	Per Cent	Cumulative
+1	63.3	63.3
+¾	3.8	67.1
+½	4.1	71.2
+⅜	3.0	74.2
−⅜	25.8	100.00

Table III—Screen Analysis of Product of 4-Ft. Symons Crusher

Size, In.	Per Cent	Cumulative
+1	18.5	18.5
+¾	26.6	45.1
+½	11.3	56.4
+⅜	13.2	69.6
−⅜	30.4	100.0

Table IV—Screen Analysis of Product of 5½-Ft. Symons Short-Head Crusher

Size, In.	Per Cent	Cumulative
+1	....	....
+¾	0.2	0.2
+½	0.2	0.4
+⅜	21.7	22.1
+¼	27.7	49.8
−¼	50.2	100.0

must be removed from the tailing before the sand is returned to the mine as fill.

Air is supplied for the thirteen cells by two Connersville Boston-type blowers having a combined capacity of 16,000 cu.ft. of free air per minute, against a maximum pressure of 2½ lb. The total length of cells is 267 ft., and the total area 1,068 sq.ft.

Reagents used are pine oil, ethyl and amyl xanthates, sodium cyanide and copper sulphate. No lime is necessary as a small amount of soluble salts in the ore and water preserve an alkalinity of pH 7.5 to 8.0. Sodium cyanide is added to the grinding circuit, the other reagents are added directly to the flotation cells.

The separate treatment of the middling simplifies the operation of the flotation section. Results depend largely upon the manipulation of the primary circuit. Depression of the pyrite is accomplished in the primary circuit. Tonnage and dilution of the middling circuit are controlled

Table V—Screen Analyses of Product of Primary Screen and of Finished Product of Crusher Plant

Size	Product From Primary Screening		Finished Product From Crusher Plant	
	Per Cent	Cumulative	Per Cent	Cumulative
+1 in.	....	....	....	....
+¾ in.	....	....	....	....
+½ in.	0.2	0.2	1.0	1.0
+⅜ in.	3.0	3.2	4.0	5.0
+3 mesh	8.6	11.8	15.7	20.7
+4 mesh	8.6	20.4	13.1	33.8
+6 mesh	6.8	27.2	14.0	47.8
+8 mesh	5.7	32.9	9.6	57.4
+10 mesh	6.2	39.1	8.1	65.5
+14 mesh	4.0	43.1	5.8	71.3
+20 mesh	2.3	45.4	4.4	75.7
+28 mesh	2.2	47.6	3.5	79.2
+35 mesh	2.4	50.0	3.0	82.2
+48 mesh	1.9	51.9	2.2	84.4
+65 mesh	2.1	54.0	1.9	86.3
+100 mesh	1.8	55.8	1.7	88.0
+150 mesh	1.8	57.6	1.1	89.1
+200 mesh	1.5	59.1	.6	89.7
−200 mesh	40.9	100.0	10.3	100.0

Table VI — Tonnages Handled and Costs in Crushing Plant

Crushing and Screening	Tons Per Hour	Cost Per Ton Crushed
Sheridan grizzly and primary crusher	190	$0.011
Primary screening	190	0.003
4-ft. Symons crusher	140	0.011
5½-ft. Symons crusher	140	0.044
Secondary screening	280	0.005
Conveying	....	0.017
Miscellaneous	....	0.016
Totals	190	$0.107

here by the flotation operator. The effect of reagent changes is immediately noticeable; within an hour the system can be completely purged of any substance that may be detrimental to flotation (such as heavy oils and greases). The flotation operator is assisted by hourly assays of the concentrate and tailing. Use of amyl xanthate was one of the developments of the separate middling treatment. Previous experiments with this reagent did not give satisfactory results.

Finally, the tailing losses caused by the weekly shutdown, on account of the 26-day legal working month, are smaller. The cells of the primary circuit are dumped first, time being allowed after the cleaning of a cell for the following cell to froth as much as possible. In like manner the middling circuit is cleaned, the rougher froth being sent to the concentrate thickener tanks, the scavenger froth being held in the middling pump sump.

Lower costs of concentration are due in part to decreased grinding costs. Some work has been done on increasing circulating loads in the grinding circuits, and plans are being drawn to revise the grinding circuits.

Table VIII — Reagent Consumption and Cost for the Year 1936

Reagent	Lb. per Ton	Cost per Ton
Pine oil	0.398	$0.034
Potassium ethyl xanthate	0.175	0.025
Potassium amyl xanthate	0.051	0.016
Sodium cyanide	0.049	0.010
Reagent cost for copper recovery	....	$0.085
Copper sulphate (activator for pyrite	0.079	0.004
Total reagent cost	....	$0.089

Table VII—Grades of Concentrate and Tailings in the Flotation Circuit

Cell	Concentrate			Tailing		
	Per Cent Copper	Per Cent Pyrite	Per Cent Solids	Per Cent Copper	Per Cent Pyrite	Per Cent Solids
Primary Circuit:						
No. 1 Rougher	29.3	1.7	51.1	0.42	3.3	38.6
No. 2 Rougher	29.4	1.5	49.7	0.34	4.2	45.3
No. 1 Scavenger	7.4	10.9	22.2	0.23	4.3	44.9
No. 2 Scavenger	0.54	5.4	20.4	0.14	4.3	46.4
Middling Circuit:						
No. 1 Rougher	16.4	23.9	42.9	4.6	22.1	26.5
No. 2 Rougher	7.3	41.5	52.0	4.5	31.4	26.7
No. 1 Scavenger	6.3	37.1	49.5	3.8	42.0	24.7
No. 2 Scavenger	5.2	36.2	41.2	2.5	22.6	16.3
No. 3 Scavenger	4.4	31.6	39.0	1.2	12.9	11.4
No. 4 Scavenger	3.2	29.7	25.4	0.37	4.5	9.0
Cleaner Circuit:						
Cleaner	28.9	3.6	43.5	6.0	52.7	37.9
Re-cleaner	31.5	3.2	44.8	12.1	39.4	9.3
Feed to primary circuit	....	....	....	4.64	3.6	43.4
Feed to middling circuit	....	....	....	4.59	23.5	19.2
Final concentrate	....	....	....	31.5	3.2	44.8
Final tailing	....	....	....	0.16	4.4	31.7

NOTE.— High dilution of feed to middling circuit is partly due to launder wash water.

3. Crushing plant

4. Shaft No. 2

5. Shaft No. 1

Concreting Bearer Sets

In a Deep Mine Shaft of the Lake Superior Iron Country

Total of 844 cu.yd. poured in 27 days by simple and ingenious scheme

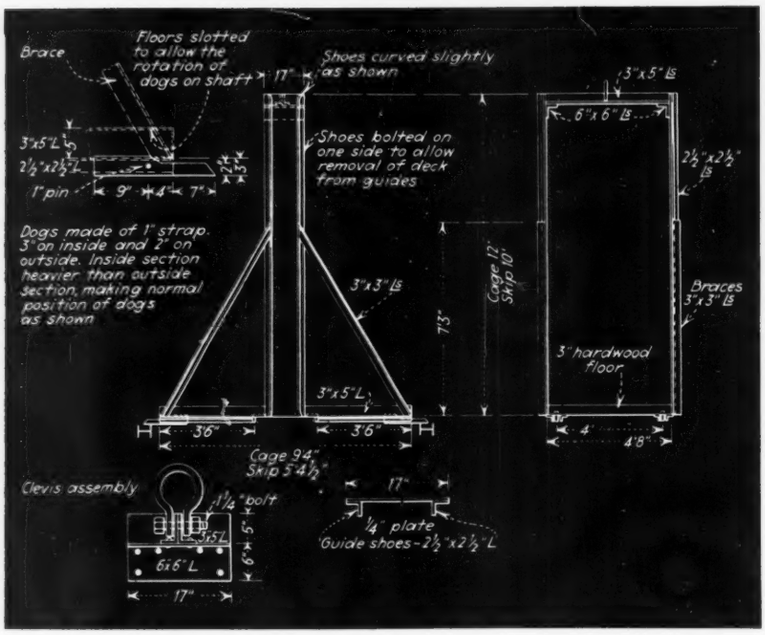


Fig. 1 . . . WORKING PLATFORMS were needed in the shaft for building forms and pouring concrete. To provide them, two cage decks and two skip decks of this design were built

BEFORE concreting the bearer sets in a deep mine shaft of the Lake Superior Iron Country, two cage decks and two skip decks were constructed to be used as working platforms in building forms and pouring concrete. These decks, which are shown in Fig. 1, were fitted with dogs, allowing the whole assembly to be moved up, the dogs rotating as contact was made with the shaft steel and straightening out to a horizontal position as the deck passed the set. The decks were made of angle iron, with ¼-in. plate and 2½x2½-in. angles serving as guide shoes. A clevis arrangement on the bridle permitted attachment to a rope and thimble suspended beneath the cages and skips and raising to the next concreting position. Floors were of 3-in. wood plank and bolted to the outside angles of the deck floor. A clearance of 4 in. was allowed between the deck floors and the shaft steel.

Two chutes were made to facilitate dumping from the mixer bucket into the hoppers in the cages. They were placed at the collar, directly in front of the cage roads, and were equipped with a hinged trough, 2 ft. 10 in. wide, which was lowered into a supplementary, slightly wider trough, which was fastened in the cage and emptied directly in to the cage hopper. When the load was discharged from the bucket into the cage, the hinged trough was pulled up to a vertical position, allowing the cage a clear road. The construction of these conveying chutes, consisting of angle iron, ⅛-in. plate, which was used for bottom and side boards, and wood plank nailing strips, is illustrated in Fig. 2.

Fig. 3 shows the construction of the cage hoppers. Two such hoppers, of approximately 31 cu.ft. capacity, were built, one for each cage, and were fastened securely to the cage floor. Angle iron, ¼-in. plate, and 2-in. wood plank were used, and a hinged chute at the bottom enabled the concrete to slide into a cone, which will be described presently. The hopper was equipped with an inlet chute, fastened to the top of the cage, which conveyed the concrete from the surface chute to the hopper. Attached to the door, at the hopper bottom, was a toggle device which allowed the door to be opened and closed from a position on the top of the hopper box. The hopper was placed as near the discharge side of the cage as possible, to enable the shortest hinged chute to be utilized.

The hopper emptied into a cone shown in Fig. 3, which was made of ¼-in. steel plate and had a top diameter of 2 ft. 1 in. and a bottom diameter of 6 in. The top of the cone was welded to a 3-in. steel plate, 3 ft. 3 in. by 2 ft. 3 in., with the cone opening cut out. To the bottom of this plate built up blocks were welded, thus enabling the cone assembly to fit firmly over the steel "H" sections of the shaft in such a way as to preclude any possibility of its slipping from the steel. An extension at the bottom of the cone, 9 in. long and 6 in. in diameter, permitted a 25-ft. rubber hose to be clamped to the cone. This hose was reinforced with ⅛-in. wire, but was very pliable and could be bent easily to fit any position required in the shaft.

Open troughs of galvanized corrugated No. 20 iron were made, 16 in. in diameter, and inclosed with rings of ¼-in. round steel for rigidity. These were made up in various lengths from 3 ft. to 10 ft. and were used to direct the flow of concrete from the end of the rubber hose to the form. The trough was supported on the hose end by blocks, as shown in Fig. 4, and the opposite end rested on the steel set. Puddling spades and hoes were made of light steel construction and were in use at all times during pouring.

Surface Equipment—A 1-cu.yd. Koerhing paving mixer was procured for the job. A 20-ft. boom, adjustable both vertically and horizontally,

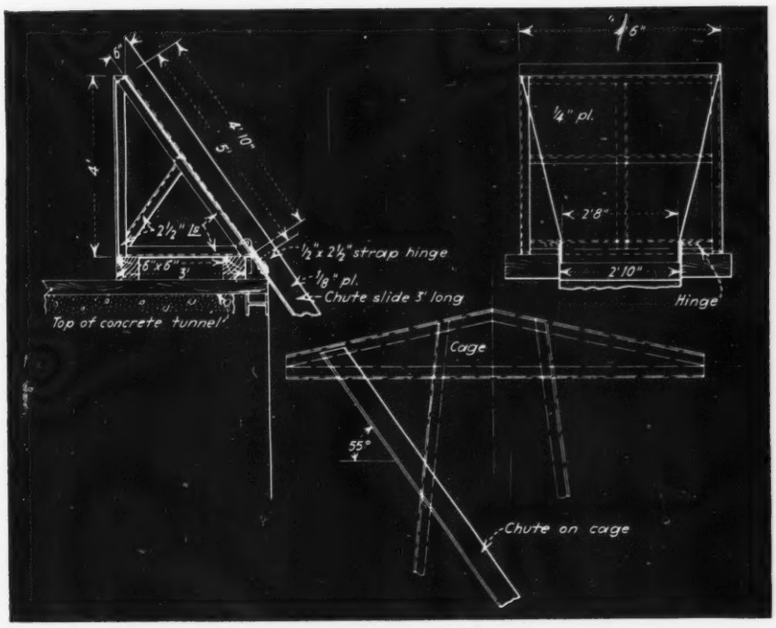


Fig. 2 . . . CHUTES, such as shown here, were built at the shaft collar and on the cages to facilitate dumping mixed concrete from the mixer bucket into the hoppers on the cages

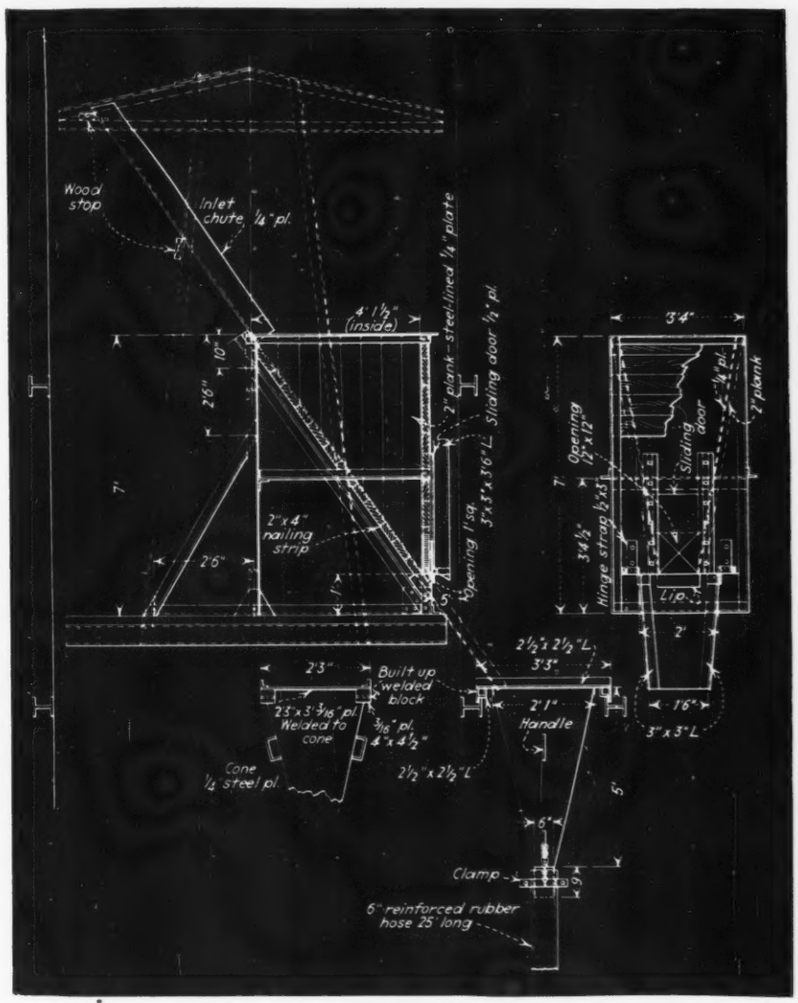


Fig. 3 . . . A HOPPER like the one shown here was built on each cage to receive, at the collar, the freshly mixed concrete which was to be lowered to the point where work was in progress, there to be dumped into the cone seen at the bottom. This cone rested on a steel H-section of the shaft and delivered its concrete to the forms through a rubber hose

conveyed a bucket from the mixer to the shaft. By swinging the boom, the bucket could be sent to either cage road without moving the mixer itself from its fixed position. Fig. 4 illustrates the method of operation. Aggregate was delivered by rail in open gondola cars and the railroad track was conveniently situated outside the headframe inclosure. The distance between track and shaft suited the space required for the mixer and was utilized. A scaffold was erected under the mixer apron so that in the loading position the top and edge of the apron abutted the top and edge of the gondola. Two bents were erected over the track, as shown in Fig. 4, and a 15-in. I-beam was placed 4 ft. off center toward the mixer. Two sliding hoists were placed on this I-beam and two dumping buckets of approximately 30 cu.ft. capacity were attached. One bucket was used for sand and the second for rock. Markings were placed inside the buckets to insure the correct amount of material being used in each batch.

The operation of the buckets is apparent from Fig. 4. By placing the beam 4 ft. off the rail center, the buckets were brought to within 1 ft. of the outside of the car, and, by a slight push, they could be dumped directly into the mixer apron. Cars were delivered filled with two-thirds rock and one-third sand, and both buckets were used in each car. Buckets were filled at any position in the car and, by use of the monorail hoists, could be moved to and dumped directly into the mixer apron, as illustrated.

Forming—Fig. 5 illustrates the method used in building the forms. After the decks were moved to the position shown and planked across the ladder and pipe road, the work of removing the lath from the bottom set commenced. These lath were moved to the set above and placed outside the lath already in place, to provide extra strength to the form. The bottom of the form was built of two layers of 2-in. hemlock plank overlapped at the corners and nailed to the bottom of the blocks. The plank next to the rock wall was cut to fit the outline of the rock and the corners overlapped as shown in the sketch. Six-inch spruce poles were used to support the bottom of the form from the set below. Three-inch plank was used to close the form from the bottom of the steel to the bottom of the form and nailed securely to the end of the tamarack blocks and to the bottom of the 2-in. hemlock plank. Dressed lumber, $\frac{7}{8}$ in. thick, was used to chink up all openings and cracks not covered by the plank. Eighteen poles supported the concrete, five being used on each wall plate and four on each end plate.

After the forms were completed, they were cleaned thoroughly of all chips and refuse, and the pouring of concrete followed.

Description of Operation—Cars of aggregate were spotted north of the shaft, the grade rising to the north. As needed, they were dropped by gravity to the desired position about midway in front of the mixer. The buckets were lowered into them, with four men assigned to rock shoveling and two to shoveling sand. A 1:3:5 mixture was used with about $\frac{5}{8}$ cu.yd. mixed in each batch. Batches were mixed thoroughly for $1\frac{1}{2}$ minutes, the time recorded on the mixer. One man, assigned to the mixer, raised the apron, watched the mixing time, emptied the batch into the bucket, pulled the bucket to the shaft chute, and emptied it. As soon as the apron was dropped on the scaffold after discharging its contents into the mixer, it was immediately filled again with aggregate, to be mixed as soon as the batch in the mixer had been discharged into the bucket. Mixing started when the cage left the bottom, as the time taken for the cage to ascend to the surface was ample for a proper mix, and by so doing the batch was conveyed to the bottom before any hardening took place.

A chute man at the shaft collar cleaned the chute after each dump and pulled the hinged trough up out of the cage chute, thus clearing the shaft for the cage. Bells, rung at the collar, notified the engineer that the cage at the collar was loaded and the shaft clear, and, upon the clearance of the cage at the concreting point, the concrete in the cage at surface was lowered to the elevation of the cones.

One man was stationed at the elevation of the cone, and, upon arrival of the cage at that position, dropped the hinged chute from the bottom of the hopper into the cone. He then notified the crew on the bottom that the concrete was there, and, when signalled, opened the door of the hopper and the load was discharged into

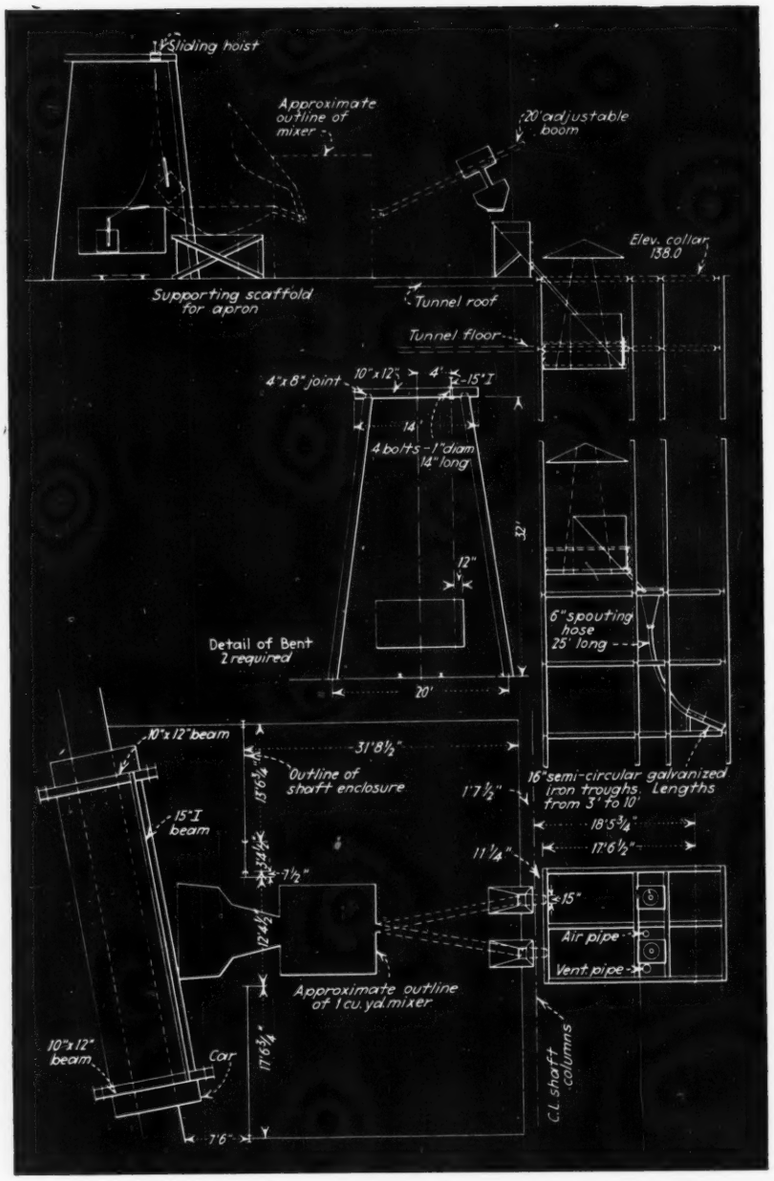


Fig. 4 . . . THE SCHEME used for mixing the concrete at the shaft collar, delivering it to the cage, and lowering it to be poured into the form below is illustrated by these two sketches, in elevation and plan respectively. A detail of the bent over the railroad track is also shown

Data on Work of Concreting Bearer Sets in Iron Country Shaft

Bearer Set	Time Forming, Hours	Time Pouring, Hours	Underground Man-Shifts	Surface Man-Shifts	Poured, Cu. Yd.	Bearer Set	Time Forming, Hours	Time Pouring, Hours	Underground Man-Shifts	Surface Man-Shifts	Poured, Cu. Yd.
18 (2 sets) (a)	(b)	32	43	35	75.6	10	9½	6	13	12	43.1
Water column support	(b)	6	9	4	8.1	9	7½	6	13	12	48.1
17 (a)	(b)	18	20	14	43 8	8	9	6	13	11	43.1
16 (a)	(b)	14	14	9	34 4	7 (2 sets)	11	11½	25	10	81.3
15 (a)	(b)	14	14	9	42.6	6	9	8	11	10	59.4
14	9½	8	13	10	42.0	5	8½	7	12	10	40.0
13	8	11	18	6	54.4	4	8	7½	12	12	44.4
12	9½	10½	14	12	43.8	3	8½	6	12	12	50.0
11	6½	6	13	12	42.0	2	10	4	12	12	48.1

(a) Sets 18, 17, 16, 15 poured using one cage only. Started using two cages on bearer set No. 14.

(b) Bearers formed prior to Sept. 12, 1935.

Shaft concreting continued from Sept. 12 to Oct. 9, 1935.

Number bearers concreted, 17.

Average forming time (single sets), 8 hr. 30 min.

Average pouring time (single sets), 9 hr.

Average man-shifts per set underground, 14.1.

Average man-shifts per set surface, 10.6.

Average man-shifts per set, 24.7.

Total cubic yards concrete poured, 844.0.

the cone and through the 6-in. hose to the form. The concrete was emptied from the hopper slowly to avoid plugging the hose. Two men handled the hose at the bottom while four men stamped and puddled the concrete. The form was filled evenly from the bottom by directing the flow from one end to another.

When the hopper was empty, the door was closed and the chute pulled up and hooked to the hopper box. The cage was then rung clear and upon the clearance of the opposite cage, it began its ascent to surface for another batch, while the loaded cage was descending to the pouring position. Toward the end of the pouring period, the surface crew was notified and batches were mixed more slowly, so that all concrete mixed could be used. On termination of the pouring, the mixer, bucket, chutes, hoppers, cones, and hoses were all washed off very thoroughly, so that no concrete remaining on them would have a chance to harden, and preparations were made to move the equipment up to the next set to be concreted.

Moving Up Equipment—Two safety chains secured the hose clamp to the cone. In preparing to move the assembly, two blocks using $\frac{3}{4}$-in. hemp rope were attached to the bridles just below the bails of the cage. Hooks were fastened to the safety chains and tightened sufficiently with the block to take the weight of the hoses. The chains were then unhooked from the cones and the cones pulled up and placed in the cages. The hoses were then hoisted up with the block and tackle and fastened to the top of the bridle, and, when clear of the steel and suspended against the bridle, were lashed firmly to it. Cages were then hoisted up to the next bearing set. The hoses were then lowered into the pipe-and-ladder compartments and the cones set back in position on the steel. When the safety chains were again attached from cones to hoses, the ropes from the blocks were removed and the equipment was again ready for use. Cages and skips were then lowered to the last concreting position, where sollar planks, tools, and other equipment had been loaded onto the decks. Decks were attached to rope slings suspended beneath the cages and skips and the four decks hoisted to the next concreting position. Work then began on the form-building of the next set to be concreted.

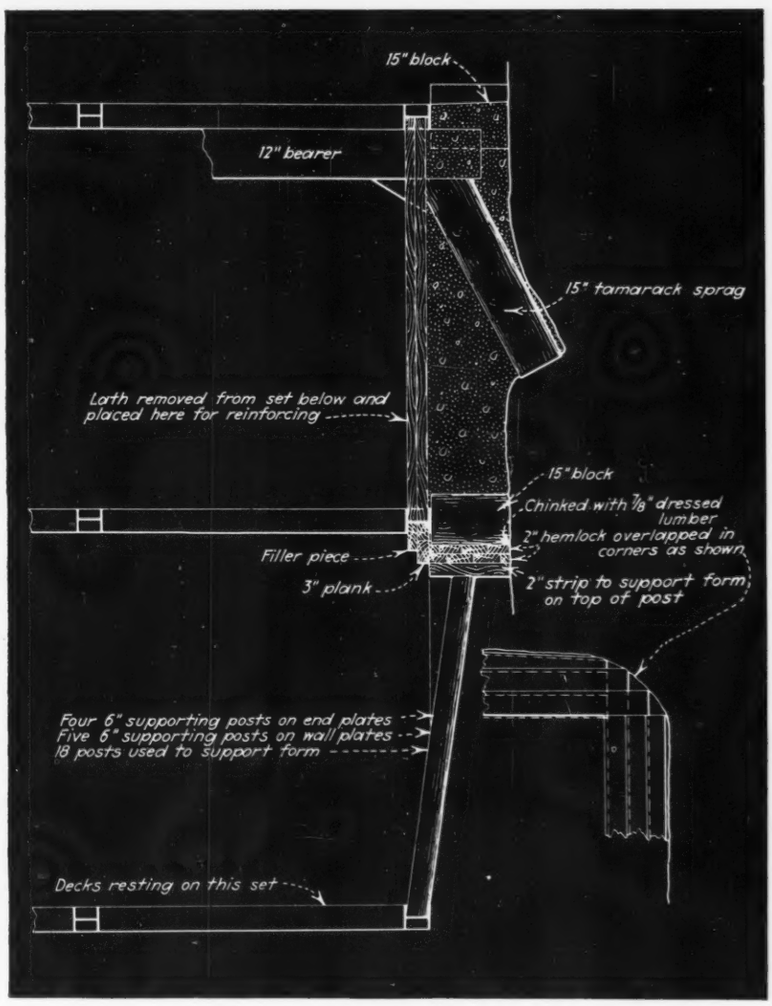
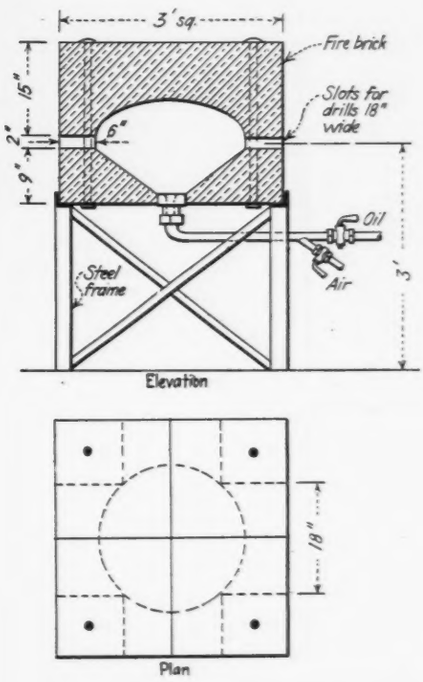

15" block
12" bearer
15" tamarack sprag
Lath removed from set below and placed here for reinforcing
15" block
Chinked with 7/8" dressed lumber
2" hemlock overlapped in corners as shown
Filler piece
3" plank
2" strip to support form on top of post
Four 6" supporting posts on end plates
Five 6" supporting posts on wall plates
18 posts used to support form
Decks resting on this set

Fig. 5 . . . FORMS were constructed as shown by this section. When finished they were cleaned thoroughly of all chips and refuse and pouring followed

▼ ▼ ▼

Simple Furnace for Heating Drill Steel

CONSIDERABLE ATTENTION has been given to a design of a rock drill furnace which will produce an even temperature at the face of the bit as illustrated in the accompanying sketch, in the opinion of A. Langley, 28 Lake Road, Stubenwall Springs, Transvaal, South Africa. The design permits of simultaneous heating of 36 bits, and, when compared with the ordinary furnace of a single slot, gives increased results in economy of fuel oil, air, and maintenance charges which warranted its adoption. At a mine in Africa that



had a drill-shop capacity of 11,000 pieces of drill steel treated per shift, the time saved on heat-treatment proved exceedingly satisfactory in upkeep, costs, and maintenance. The furnace is of simple construction, being built with interchangeable firebricks domed inside to concentrate the heat of the flame at the face of the bit. A regulating valve maintains an even pressure of oil and air.

More About Russian Gold

Soviet Figures Confirm Doubts On High Gold Production

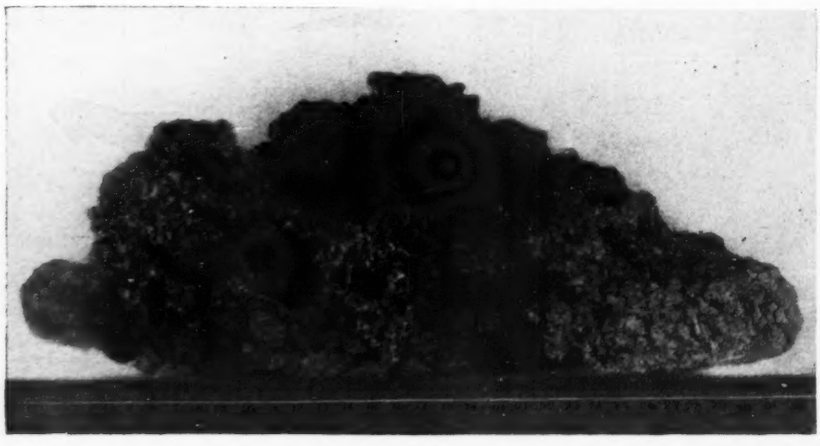
H. C. Chellson
Assistant Editor

CONFUSION within the Soviet Union during the year may be responsible for the lack of consistency in estimates by the outside world on Russia's gold production for 1936. Estimates ranging from below 5,000,000 oz. to 10,600,000 oz. have been made, and continued absence of official announcement from U.S.S.R. Government sources on this subject forces the outside world to use data in Soviet publications or reported statements made by Soviet Government officials. The basis of figures presented in ounces and kilograms herewith on the chart (Fig. 1) is obtained from a Soviet source and these may throw some light on this much-discussed subject. Some foreign observers familiar with the Soviet gold-mining industry accept these figures from 1930 to 1935 as rational, considering the rising production from several extremely rich deposits and the severe drive to boost Soviet gold production. The 1936 figure, however, is considered a preliminary estimate by Soviet authorities, and the final figure, if and when announced, may be lowered.

The graph is reproduced from the attractive Soviet publication "USSR in Construction," May, 1937. The original indicates the Russian manner of reporting only percentage increases, omitting anything concrete for a starting point, and lists only the years 1930, 1932, 1934, 1936, and 100, 131, 257, and 440 per cent respectively. Gold output in 1930 based on Soviet statement, however, is described in *E.&M.J.* for June, 1935, pp. 277–278, as follows: "An article in Sovetskaya Zolotopromyshlennost [21] furnishes percentage figures, on the basis of which it is possible to calculate the production of gold in the various quarters of the years 1930 to 1932 shown in Table XVII." The table referred to is Table I of this article, which shows 44,593 kg. produced in 1930. Using 32.15 oz. troy to a kilo, the output was 1,433,664 oz. The 1931 production, also obtained from Table I, shows 52,907 kg. or 1,700,960 oz. Using the 131 per cent figure on the chart for determining the output for 1932, production reached 58,416 kg., or 1,878,101 oz. This is lower than the figure given in Table I, but the difference may be attributed to more accurate data available in 1937 about 1932 production, than in 1933; therefore, the use of 131 per cent as indicated on the chart. The next figure given by this Soviet publication is a percentage increase in 1934, omitting the 1933 production. It is known, however, that Stalin told Walter Duranty in an interview in Moscow on Dec. 25, 1933, that Soviet gold production in 1933 was valued at more than 100,000,000 gold rubles. In Russia the value of one gram of gold is 1.29 gold rubles, and the production for 1933 can, therefore, be conservatively determined at 77,511 kg., or 2,492,240 oz., which is slightly above the value of 100,000,000 gold rubles.

The percentage gain in 1934, shown to be 157 per cent above 1930, produces the total of 114,604 kg., or 3,684,519 oz., for that year. This represents a substantial increase above 1933 and is probably accounted

[21] 1933 Nos. 6 and 7, p. 3.



GOLD NUGGET . . . . 32 centimeters long weighing 14,470 grams (465 oz.) was found in a mine in the Tyelgin gold field near Miass, in the Ural Mountains, in 1936. The remainder of the nugget was removed and the total weight including the piece above was 32,659 grams (1,050 oz.)

KREMLIN IN MOSCOW . . . . Artistic buildings within this famous Kremlin wall serve as museums of priceless art treasures and headquarters of Soviet Government officials well known for their political planned economy and strenuous efforts to exploit the natural mineral resources of their vast country. Endowed with substantial gold deposits but faced with need of base metals, the country plods forward, announcing its progress to the proletariat parading in the streets each May Day. Official figures on gold production, however, remain secretely guarded and unshared with the more liberal-minded members of the world's gold-mining industry

for by the increased mechanization and starting of several new cyanide and flotation plants in the Far East, and by a larger number of persons attracted by the opportunity to obtain better food and clothing in the gold fields.

The 4,996,207 oz. produced in 1935 was determined by interpolation, employing the production for 1934 and 1936 determined from Soviet data on the chart. Many observers of Soviet gold production, in the absence of official data, used 40 per cent as the increase in 1935 above 1934, as this figure was released in the Soviet press. The percentage increase for 1935 determined from data on the chart shows the increase to be only 35.6 per cent.

Using the Soviet figure of 340 per cent increase for 1936 above 1930, it is found that output was 6,308,119 oz. Possibly the figure 340 per cent of increase was influenced by customary Soviet optimism, and perhaps at some future time, when Russia has assembled all data for 1936, at least a percentage graph will be released showing a more accurate figure. The conservative estimate by the United States Bureau of Mines of 5,240,000 oz. for 1936 may, therefore, approach closer to the final figure. The Bureau estimates the same production as on the graph for 1930-1931, but its figures are higher for 1932, 1933, 1934, and lower estimates are made for 1935 and 1936. See Table IV.

American mining engineers familiar with the major gold lode and placer mines throughout the Soviet Union credit the country with several unusually rich and well-equipped lode deposits in the Trans-Baikal region, such as the Darasun, Balei, Minusinsk and Jitagara districts, where the Gold Trust is concentrating the addition of even more new mine and mill equipment to increase production. Balei alone is estimated to have produced 10 metric tons of gold in 1936. A 1,000-ton plant is in operation here. Darasun is a growing district where the average gold content is about 25 grams. The Minusinsk district has about five plants of from 150 to 500 tons per day, treating one quarter- to half-ounce ore. In addition to these rich developed lode mines, about 85 gold dredges are in use among sixteen gold-producing districts, about 27 dredges are employed in the Urals, 22 in the Yenesai River region, and about 8 in the Yakut region, with the remainder distributed among the smaller fields. The Stakhanov movement in gold mining is rapidly being absorbed by the "Artel" movement, and mine officials are told to encourage this movement as much as possible. This system is somewhat similar to "leasing" in this country. A group of men, from two in number up, literally become a private enterprise or corporation, work a certain mine,

Table I—Trend of Soviet Gold Production, 1930-1932 . . . By Quarters

	1930		1931		1932	
	In Per Cent of Total Production	In Kilograms (Calculated)	In Per Cent of Total Production	In Kilograms (Calculated)	In per Cent of Total Production	In Kilograms (Calculated)
First quarter	12.3	5,485	10.6	5,608	17.2	10,647
Second quarter	25.8	11,505	26.0	13,756	28.0	17,332
Third quarter	43.7	19,487	37.6	19,893	34.7	21,479
Fourth quarter	18.2	8,116	25.8	13,650	20.1	12,442
Totals	100.0	44,593	100.0	52,907	100.0	61,900

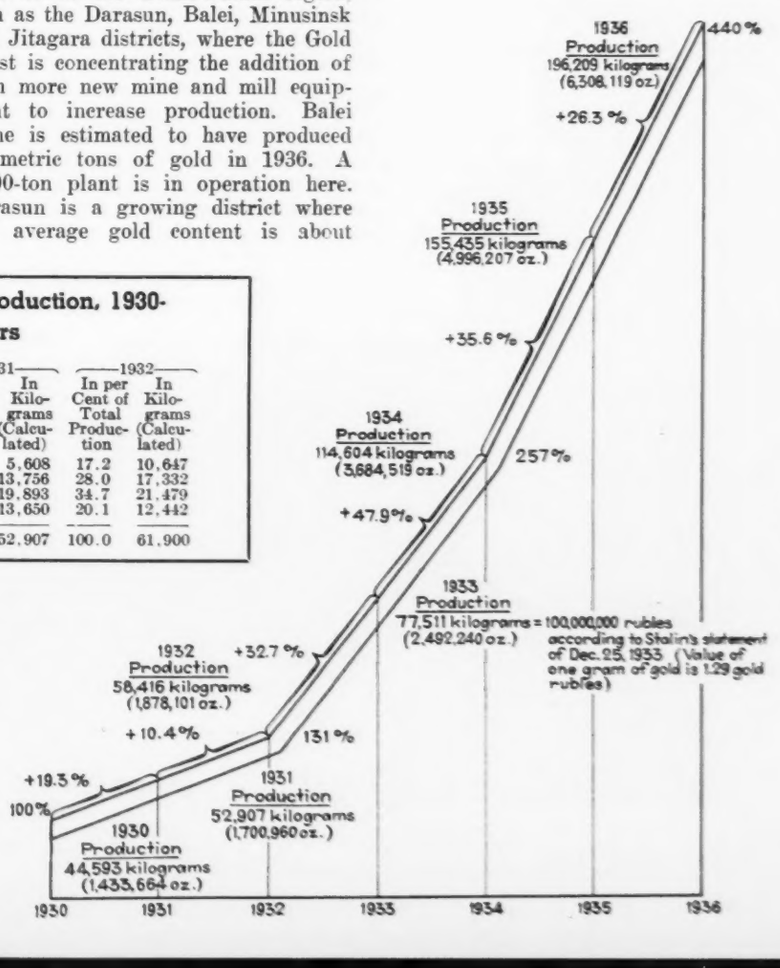


Fig. 1 . . . GRAPH OF RUSSIAN GOLD PRODUCTION since 1930 using as a base for yearly estimates 44,593 kg. produced in 1930 determined from an article in "Sovetskaya Zolotopromyshlennost," 1933. This line graph and percentage increases shown for 1930, 1932, 1934, and 1936 were taken from the May, 1937, issue "USSR in Construction." Production figures and yearly percentage increases have been determined and added herewith to the original graph. A. Serebrovsky, head of Gold Trust, reported to J. Stalin 1936 output was 26 per cent above 1935; 26.3 was determined on graph.

Table II—Copper, Lead, and Zinc Production in U.S.S.R.

American Bureau of Metal Statistics

(In Metric Tons. One Metric Ton = 2,204.6 Lb.)

	1930	1931	1932	1933	1934	1935	1936
Copper	34,105	31,097	30,678	32,690	44,078	63,247	83,000
Lead	8,625	16,140	18,717	13,671	27,202	36,800	50,800
Zinc	4,329	9,196	13,656	16,620	27,151	46,196	66,000

Table III—Gold Recovered From Base-Metal Mines

In Kilograms and Ounces

	From Copper Ores		From Lead Ores		From Zinc Ores		Total	
	Kilograms	Ounces	Kilograms	Ounces	Kilograms	Ounces	Kilograms	Ounces
1930	2,046	65,779	526	16,911	264	8,488	2,836	91,178
1931	1,866	59,992	985	31,668	561	18,037	3,412	109,697
1932	1,841	59,188	1,141	36,683	833	26,781	3,815	122,652
1933	1,961	63,046	834	26,813	1,014	32,600	3,809	122,459
1934	2,645	85,036	1,659	53,337	1,656	53,240	5,960	191,613
1935	3,795	122,009	2,245	72,178	2,818	90,598	8,858	284,785
1936	4,980	160,107	3,099	99,633	4,026	124,436	12,105	389,176

Table IV—Gold Produced by Gold Trust, Base-Metal Mines, and Kolina Region

Estimated in Kilograms and Ounces

Year	Gold Trust		Base-Metal Mines		Kolina Region		Total Gold		Percentage Increase	Estimate by U. S. Bureau of Mines, Ounces
	Kilograms	Ounces	Kilograms	Ounces	Kilograms	Ounces	Kilograms	Ounces		
1930	35,757	1,149,586	2,836	91,178	6,000	192,900	44,593	1,433,664		1,433,664
1931	41,495	1,364,063	3,412	109,697	8,000	227,200	52,907	1,700,960	19.3	1,700,960
1932	44,601	1,434,299	3,815	122,652	10,000	321,150	58,416	1,878,101	10.4	1,990,085
1933	58,702	1,887,531	3,809	122,459	15,000	482,250	77,511	2,492,240	32.7	2,667,100
1934	87,644	2,817,756	5,960	191,613	21,000	675,150	114,604	3,684,519	47.9	3,858,089
1935	119,577	3,843,372	8,858	284,785	27,000	868,050	155,435	4,996,207	35.6	4,784,030
1936	149,104	4,793,693	12,105	389,176	35,000	1,125,250	196,209	6,308,119	26.3	5,240,000

or part thereof, or agree to work a placer area. They obtain credit for air, use of equipment, powder, fuse and caps, and other supplies, from the mine management, and these charges are deducted each month and final settlement is made through the State Bank branch or gold store at the mine. The gold rubles or exchange coupons are divided among the members of the artel, and if returns are high, a celebration is in order, and more expensive items are bought at the gold store, such as bicycles and accordions, and in some cases automobiles are ordered or perhaps a surplus of food and clothing is purchased. Many artels have netted substantial incomes.

Many artels move from placer mining in summer to lode mining in winter, and a high percentage of men and women on straight pay devote their after hours placering or working in an artel to increase their income. The total number of persons employed throughout the many gold-mining districts is estimated at 750,000.

Gold produced from mines, gold dredging, hydraulicking, placering, and artels is reported to the "secret department" of local mine managements, which submit reports to the central Gold Trust in Moscow. The four largest gold lode mining districts, however, report directly to Moscow. Another source of gold is from the base-metal mines, which is independent of the Gold Trust, and the third principal source of gold considered independent of the Gold Trust is that produced in part by political exiles in the Kolina field, in northeastern Siberia near the Arctic Circle. This output is sometimes called "G.P.U. gold."

Estimates by engineers familiar with gold content of the chief base-metal mines believe that on the average about 60 grams of gold is recovered from each metric ton of refined copper produced and about 61 grams is recovered from each ton of zinc and lead. Most of the copper production comes from the Ural Mountains, where gold is found in the oxidized and leached zones of the pyritic deposits. Mines in the Ridder district, in eastern Kazackstan, are the highest producers of zinc and lead, and, therefore, account for a large part of gold recovered in base metals, as the ore contains about 12 grams gold per ton.

Table II shows the production of copper, lead, and zinc since 1930 and the estimated gold recovered on the basis mentioned is contained in Table III. Table IV shows the estimated breakdown of gold produced by the Gold Trust; that recovered from base-metal mines, and the estimated production from the Kolina region. The Kolina region has numerous rich placer areas and many thousands of experienced placer miners. Roads have been built and supplies are brought in by airplane, railroad, and truck, and in 1936 this region made a substantial contribution to gold output. Large sums have been allotted for newly developed lode mines that indicate large production, and during the third five-year plan beginning in 1938, total gold production no doubt will show a slight increase from year to year, with the bulk of the output increasing from lode mines. The production in 1937 is expected to show an increase above last year's, but some observers believe the recent unsettlement throughout the country brought on by the "spy scare" has in some degree retarded production, due to general apprehension and sudden removal of responsible engineers and mine managers. Since no unemployment is reported in the Soviet Union, it is difficult to understand how more people can be encouraged to enter gold mining without affecting the greater production plans of the industry they leave. Meanwhile, the Soviet will maintain its position as the world's second largest gold producer, at least for the next few years.

AN ENTERPRISING ARTEL . . . . having four members. Three maids and a man operate this placer unit in the Southern Urals. Clean-ups are brought to the State Bank and exchanged for coupons that are divided among the "stockholders."

Correcting Vertical Angles

When Top Telescope Is Used

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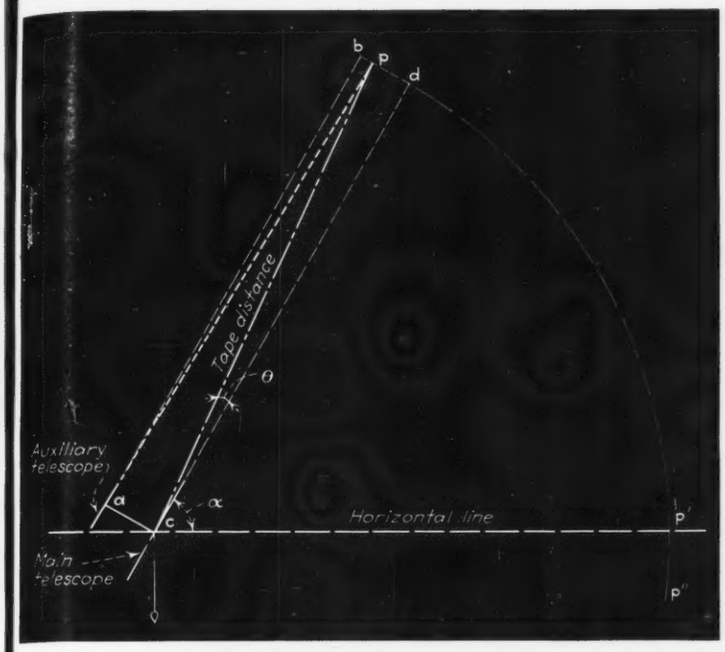

Fig. 1 . . . SIGHTING up raise. a, Vertical angle read. θ, correction angle

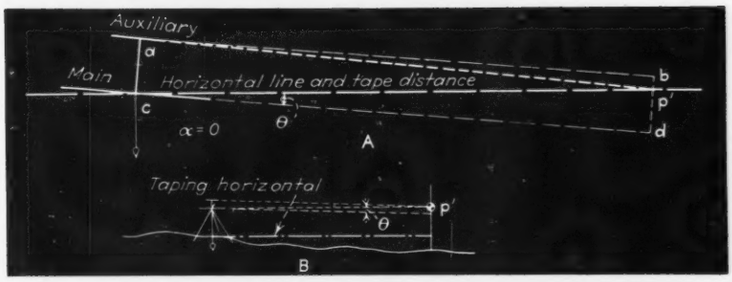

Fig. 2 . . . MEASURING the correction angle θ, using the level rod

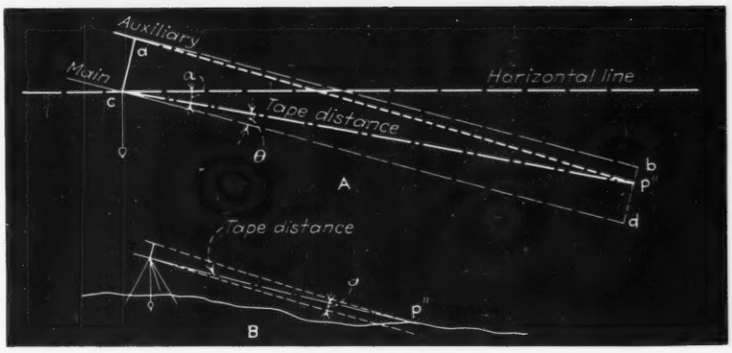

Fig. 3 . . . MEASURING the correction angle θ, without the level rod

WHEN MEASURING vertical angles by means of the top telescope, it is customary to first make the lines of sight of the main and auxiliary telescopes parallel. Then if the distance between the two lines of sight is determined, the angle read with the top telescope differs from the angle that would be read by the main telescope by

$$\text{Sin}^{-1}\ \frac{\text{Distance between lines of sight}}{\text{Tape distance}}$$

The tape distance is measured from the horizontal axis of the main telescope to the point.

This paper deals with a method for correcting the vertical angle without first making the lines of sight parallel. They should, however, not converge enough to cross before the sighted point.

In the discussion the vertical cross hairs are assumed to be in line. Consulting Fig. 1, P is the point sighted with the top telescope. Line $c\ d$ is the line of sight of the main telescope. Line $a\ b$ is parallel to $c\ d$. Line $a\ P$ is the line of sight of the top telescope and, as may be seen, is not parallel to the line of sight of the main telescope. The point c is the horizontal axis of the main telescope and the line $c\ P$ is the tape distance.

When sighting at the point P with the top telescope, the vertical angle read is α. If the point P could be sighted with the main telescope, the vertical angle would be $\alpha + \theta$, which is the angle desired. The angle θ is then the correction angle.

Consider the telescope to be dipped down until the point P following a circular arc falls on the horizontal line through the main axis, at P'. The top telescope will be sighted at P' and $cP = cP'$. The main telescope will be depressed below the horizontal by the correction angle θ. Conditions are shown in Fig. 2, *A*.

Then the method for determining θ after the angle has been measured by use of the top telescope is as follows: At any convenient place where the floor is fairly level, lay off the tape distance horizontally from the instrument. At this point place a level rod and set the target on a horizontal line through the main axis, with the main telescope. Sight the target with the top telescope and the correction angle may be read because the main telescope will be depressed below the horizontal by this angle. The set-up is shown in Fig. 2, *B*.

The correction angle may be determined without a level rod in the following manner: Stretch a string or a tape on the ground in a straight line from the plumb bob of the instrument. Sight the main telescope along this line. Lay off the tape distance from the horizontal axis to a point on this line. Measure the vertical angle to this point with the main telescope and with the top. The difference between the two readings is the correction angle θ. The conditions are illustrated in Fig. 3, *A* and *B*.

The principle to bear in mind is, that if the vertical angle is measured to a point by the main telescope and by the top telescope the two angles will differ by the same amount regardless of where the point is situated in space provided the point is always situated at the same distance from the axis of the main telescope.

A Manganese Recovery Problem And Its Solution

Flotation of dioxide from current mill tailings at Philipsburg is studied in effort to recover it in form suitable for dry cells

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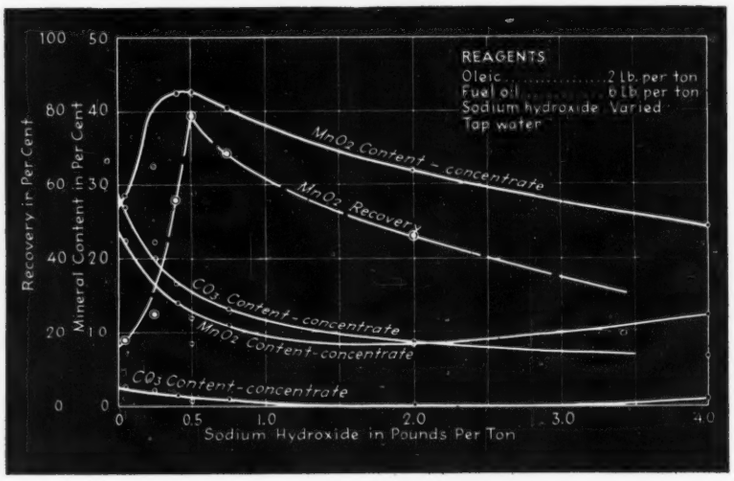


Fig. 1 . . . VARIATION IN ALKALINITY was found to have an effect on the flotation of manganese dioxide. These graphs show the results of using sodium hydroxide in various quantities

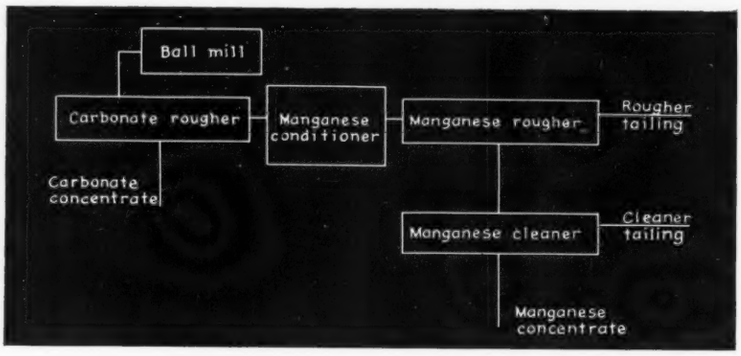


Fig. 2 . . . CONCENTRATION of manganese dioxide by flotation seems to be best accomplished by depressing the manganese and floating the carbonates, with subsequent activation and flotation of the manganese dioxide, as in this flowsheet

MANGANESE dioxide ores from the Philipsburg district of Montana are currently concentrated by magnetic and gravity methods. Tailings from these operations are relatively high in grade; in fact, they have been found valuable enough to justify shipment without concentration to the iron plant at Provo, Utah. Because of their grade and purity, the concentrates are sold to the dry-cell industry and bring a higher return than if sold for iron making. The problem of recovering from the current tailings additional quantities of manganese in a form suitable for the dry-cell industry is therefore attractive.

The problem, the solution of which was undertaken, was the treatment by flotation of a specific product; namely, the tailing from the magnetic separator plant of the Moorlight Mining Company. However, the literature on the flotation of managanese dioxide is so meager that much time was spent ascertaining the flotation behavior of manganese dioxide in the presence of various gangue minerals.

Specifications of the dry-cell industry as to available oxygen content and the amount and kind of impurities are rigid. A maximum of 2 per cent carbon dioxide and a minimum of 70 per cent manganese dioxide are required of acceptable concentrates.

Philipsburg manganese is in the form of the dioxide and is said to be pyrolusite. "Pyrolusite" is commonly used as a "blanket" term to include many manganese minerals containing manganese dioxide regardless of water, manganous manganese, or iron content. These minerals are lumped under one head even though their physical and chemical properties are different. Needless to say, the flotation properties of such assorted minerals may not all be the same.

Philipsburg ore is very friable, due to the softness of part of the oxide. The chief gangue minerals, besides quartz and silicates, are calcium carbonate, with some dolomite or magnesite. Though locked particles are common in the Moorlight magnetic separator tailing, it appears, as a first approximation, as if grinding to the usual flotation size will achieve a substantial degree of liberation. The locking problem was, therefore, overlooked in this preliminary study.

The difficulty of floating manganese dioxide is enhanced by the formation of much slime during grinding. Recovery of the slimed manganese is low, resulting in a poor over-all recovery. Essential flotation problems are therefore: (a) a three-cornered separation of manganese dioxide, alkaline-earth carbonates, and silicates, and (b) reduction of losses of slimed manganese to the minimum.

Reagents—To float the manganese it is essential, in so far as experimentation has been conducted, to use either a fatty acid or a soap; furthermore, the fatty acid radical should have a fairly long hydrocarbon chain. The following fatty acids were experimented with: palmitic, stearic, oleic, undecylenic, pelargonic, formic, and acetic. Acetic and formic acids were found worthless and pelargonic and undecylenic acids were unsuitable

Table I

Reagents (Added in Cell)

	Lb. per Ton		Lb. per Ton
Oleic acid	2.0	Sodium hydroxide	0.5
Fuel oil	6.0		

pH 7.8

Results

Product	Weight Grams	Assay % MnO_2	Assay % CO_3	Per Cent of Content in Flotation Feed MnO_2	Per Cent of Content in Flotation Feed CO_2
Concentrate	1,000	21.92	5.31	.....	.....
Feed	287	42.4	12.0	78.7	94.0
Tailing	406	8.2	0.54	21.3	6.0
Slime (by difference)	(307)	(21.0)	(5.5)	.....	.....

Table II

Reagents (Added in Cell)

	Lb. per Ton		Lb. Per Ton
Oleic acid	2.0	Sodium hydroxide	0.5
Fuel oil	6.0	Sodium oxalate	5.0

pH 7.2

Results

Product	Weight, Per Cent	Assay % MnO_2	Assay % CO_3	Per Cent of Content in Flotation Feed	
Feed	100	21.92	5.31	.....	.....
Slime (by difference)	(39.0)	(21.00)	(4.77)	.....	.....
Rougher concentrate	(32.0)	(40.0)	(10.62)	(93.7)	(98.7)
Rougher tailing	29.0	3.0	0.16	6.3	1.3
Cleaner concentrate	26.0	45.7	12.8	86.5	96.5
Cleaner tailing	6.0	16.4	1.25	7.2	2.2

Table III

Reagents

Ball mill	Lb. per Ton	Manganese rougher	Lb. per Ton
Sulphuric acid	3.68	Barrett No. 4	0.71
Dextrine	4.0	Oleic acid	2.63
Oleic acid	1.0	Sodium carbonate	1.5
Carbonate rougher		**Manganese cleaner**	
Oleic acid	2.1	Sodium silicate	1.0
Barrett No. 4	0.21		
pH 7.4		pH 8.0	
Manganese conditioner			
Potassium sulphite	8.0		
Ammonium oxalate	4.0		
Sodium silicate	4.0		

Results

Products	Weight, Grams	Assay % MnO_2	Assay % CO_3	Per Cent of Manganese in the Flotation Feed
Feed	500	19.96	6.72	....
Rougher manganese concentrate	(105)	(54.3)	....	....
Rougher carbonate concentrate	115	15.5	....	17.3
Rougher tailing	195.5	9.5	....	18.0
Slime decanted	84.5	20.0	....	16.4
Cleaner manganese concentrate	75	63.5	1.42	40.1
Cleaner tailing	30	33.9	....	8.2

Remarks — The pulp, before the manganese rougher, was conditioned for 20 minutes at a pulp density of approximately 30 per cent solids.

Table IV

Reagents

Ball mill	Lb. per Ton	Manganese rougher	Lb. per Ton
Sulphuric acid	3.68	Oleic acid	2.6
Dextrine	4.0	Barrett No. 4	0.71
Oleic acid	1.0		
Carbonate rougher		**Manganese cleaner**	
Oleic acid	2.63	Sodium silicate	0.5
Barrett No. 4	0.42	Barrett No. 4	0.14
pH 7.4		pH 7.6	
Manganese conditioner			
Potassium sulphite	8.0		
Ammonium oxalate	4.0		
Sodium silicate	3.5		

Results

Products	Weight, Grams	Assay % MnO_2	Assay % CO_3	Per Cent of Manganese in the Flotation Feed
Feed	500	19.96	6.72	....
Rougher manganese concentrate	(107)	(59.7)	....	....
Rougher carbonate concentrate	109	14.4	....	18.06
Rougher tailing	243.7	5.0	....	14.04
Slime decanted	40.3	19.3	....	8.94
Cleaner manganese concentrate	72	59.7	2.14	49.5
Cleaner tailing	35	23.5	....	9.46

Remarks — Before going to the manganese rougher the pulp was dewatered to approximately 30% solids and conditioned for 30 minutes in a small conditioner.

because of the wild froth they created. Stearic and palmitic acids did not appear promising: they had to be added in solution in organic solvents, and these solvents all produced uncontrollable overfrothing. Oleic acid was the best collector for the manganese, but stearic, palmitic, and undecylenic acids seemed more selective in respect to flotation of the carbonates in the presence of pyrolusite.

Fuel oil, when used in a collective float, seemed to have a beneficial effect upon the flotation of manganese dioxide and also to give a float substantially freer of gangue silicates. Rather large amounts were required for these effects to be noticeable. But, as the fuel oil smears itself on the fatty-filmed surfaces of the pyrolusite, it is difficult to remove it in later steps, as, for example, if it is desired to depress the pyrolusite after once having floated it. So in later tests, silicate-gangue depression was sought by other means than by the addition of fuel oil, as by the use of sodium silicate. It may well be, however, that fuel oil will find a place as a reagent in the treatment of manganese ores, especially since conditions in practice as to overfrothing are not exactly duplicated in the laboratory.

Considerable variation in flotation was observed with variations in alkalinity. The results are summarized in Fig. 1. With too much alkali a wild froth was obtained and with the addition of acid (to yield a pH below 7.0) the floatability of manganese dioxide was decreased.

The tap water was found to have quite a bearing on the behavior of the minerals during flotation. Just exactly what impurity was responsible for this effect was not determined. The chief impurities in Butte water are calcium, magnesium, sulphate, and bicarbonate. To remove the element of uncertainty due to impurities in water, distilled water was used.

Sodium silicate is found to be a particularly desirable reagent, not only because of its function as a depressant of gangue silicates but also because it seemed to increase the floatability of the manganese dioxide. It is likely that its usefulness is derived in part, but in part only, from its alkaline properties.

A number of modifying agents were experimented with aside from those used for pH control. These included oxidizing agents, reducing agents, protective colloids, and other organic compounds containing much oxygen in their molecules. Generally speaking, oxidizing agents prevent or retard the flotation of manganese dioxide. It is possible that the formation of coatings on the manganese dioxide is hindered by the presence of oxidizing agents which do one of two things in this respect: (1) they may favor the decomposition of non-polar coatings on the manganese particles, or (2) they may make the manganese particle surface so unreactive as to prevent formation of non-polar coatings.

Practically speaking, the most effective oxidizing agents used were potassium chlorate and chlorinated lime (calcium oxy-chloride). In two comparative tests (with oleic acid), one in which potassium chlorate was used resulted in a relatively clean carbonate rougher concentrate, and the other in which potassium chlorate was not used resulted in a carbonate concentrate containing a considerable amount of manganese dioxide.

On the other hand, reducing agents favor the flotation of manganese dioxide. This may be seen in the metallurgical results of tests in which

sodium oxalate was used and omitted, respectively. (Tables I and II).

It is possible that the effectiveness of oxalic acid and the oxalates is due to the promotion of the formation or to the protection against destruction of non-polar coatings on the pyrolusite through the reducing action of the oxalate radical.

The theory which is put forth here to explain the usefulness of some oxidizing agents to inhibit the flotation of manganese dioxide and of some reducing agents to promote the flotation of manganese dioxide is suggested by the fact that manganese soaps are manganous compounds which upon oxidation are converted to manganese dioxide; manganese soaps may not be retained undecomposed except in the absence of oxidizing agents. The same thing may be true of any other manganese-bearing heteropolar filming compounds that may form on the pyrolusite (referred to in the foregoing, for short, as non-polar coatings because of their having the non-polar side of the coating away from the mineral). That the hypothesis in this paper is no more than a working hypothesis was made plain to us when we found some reducing agents which not only did not act as expected, but acted in the opposite way, as, for example, dextrine, citric acid and its salts, and the tartrates. Far from promoting the flotation of manganese dioxide, dextrine prevents it—with this advantage over oxidizing agents that its effect is less permanent and is subject to relatively rapid reversal through the use of oxalates.

Flowsheets—There are many ways in which the problem of concentrating manganese dioxide by flotation may be approached. The methods tried were as follows:

1. A bulk float of the manganese.
2. The removal of the silicates and carbonates from the manganese, in a froth, after first depressing the manganese.
3. Depression of the manganese and floating of the carbonates, with subsequent activation and flotation of the manganese dioxide.
4. A bulk float of the carbonates and manganese, with subsequent depression of the manganese and removal of the carbonate in the froth.

Method 3 appeared to be best.

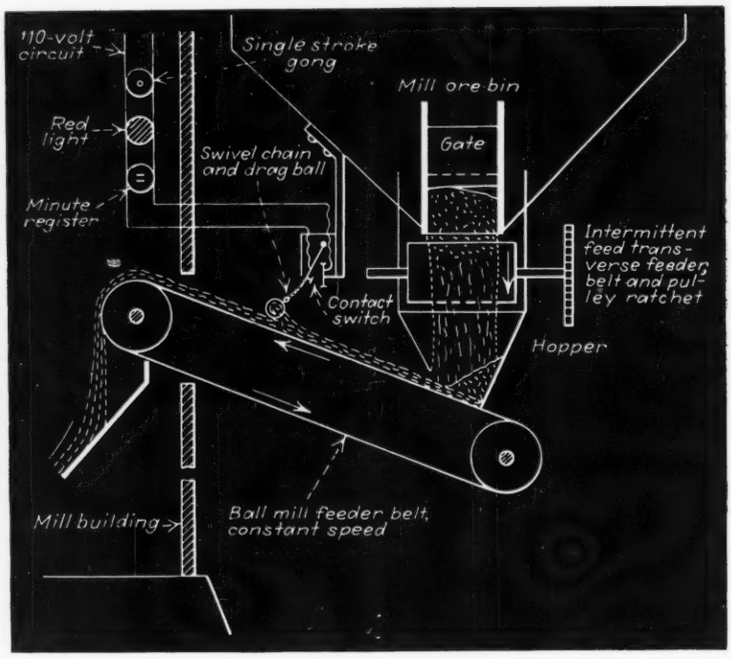
Bulk flotation of the manganese and carbonates followed by depression of the manganese from the bulk float was attempted. The chief troubles with this method were that, after being floated once, the manganese was hard to depress, and that silicates in the bulk float became concentrated with the manganese upon re-treatment. With careful cleaning of the bulk concentrate and proper conditioning, this method may have some utility.

The most promising method for the flotation of this type of feed is the flotation of the carbonate minerals, while depressing the manganese dioxide, and then floating the manganese away from the silicates. For the activation of the manganese dioxide it was found necessary to condition the pulp at an increased pulp-density.

The accompanying tables record some of the experimental results obtained to date. The flowsheet is shown in Fig. 2 and the reagents and metallurgical results are presented in Tables III and IV. Although the results are not to be regarded as economically satisfactory, they show that a separation is possible, and there is no doubt that further application to this problem will result in an acceptable solution.

We wish to express our appreciation to the staff of the Moorlight Mining Company and of the Trout Mining Company in Philipsburg for their many courtesies both in guiding visits through the plants and in helping secure a variety of samp'es.

Telltale and Recorder Check Ball-Mill Feeder Operation



ALLAN F. LAKE, e'ectrician for California Standard Gold Mines Corporation, at Jamestown, Calif., has devised a tell-tale for recording "no feed" when the feed to the ball-mill in the company's Erin-go-Bragh mill is stopped for any reason. This consists of a ball which is dragged up the feeder belt by the ore stream, as shown in the cut, so long as the feed is uninterrupted. When the ore fails on the belt, the ball swings back down the slope, thereby closing a contact switch, which rings a single-stroke gong, lights up a conspicuously located red light, and actuates an electric recording device which registers minutes. The latter is a Graybar GE Type KT time meter, operating on 115 volts and 60 cycles, which records current minutes.

The ball mill is also connected to a GE Telechron clock in the office which records the time the mill runs and which stops with the mill.

Both the "feed-off" record and the Telechron record are taken at the beginning of each shift and entered in the mill log of the preceding shift. In this way, and with the aid of half-minute weight samples, taken by hand every half hour, an accurate account is kept of tonnage milled.

Reverberatory Smelting Of Rich Gold Residues

In Great Britain

Plant and process simple — Reliance placed on ancient principle that bulk of gold and platinum metals is absorbed by lead

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45 Bentinck St.
Glasgow, Scotland

THE SMELTING of rich gold residues is customarily performed in smelters in Great Britain in the reverberatory furnace, to secure an immediate return of the gold values and thus avoid a loss of bank interest. No attempts are made to produce a clean slag. The slag produced must be transferred to the blast furnace to eliminate the remaining precious metal. The rich gold residues come from all parts of the world, and are the product of a wide variety of treatments.

Decision as to whether such residues are to be smelted in the reverberatory or the blast furnace depends on the respective costs of these two processes. In one works, material which was less than £200 (British money) per ton was made into briquets and smelted directly in the blast furnace. Residues beyond this limit were treated on the reverberatory hearth.

Some residues are worth upwards of £1,000 per ton, but the accompanying base metals and waste materials offset any advantage of attempting wet treatment, at the initial stages. The rich residues, or "sweep," are charged to the reverberatory, together with arsenical lead and a small addition of poor matte or similar material containing sulphur, which will eventually form an intermediate layer of matte. The object of so working is that the bulk of the gold passes into the lead, together with most of the platinum metals and much of the silver. The matte contains practically the whole of the remainder of these metals, as a protective covering, and the slag is usually sufficiently rich to justify re-smelting in the blast furnace.

Smelting is carried out by unskilled labor throughout, and despite the high value of the contents, calls for little experience in dry metallurgical practice. The fumes evolved pass to condensing towers of the old-fashioned water-cooling system, and the deposited mud so collected is dried and smelted, whereby arsenical lead is recovered for treatment of succeeding charges of gold residues. From this it will be gathered that the lead and arsenic are continually passing round the process.

The idea of using arsenic was originally worked out by D'Hennin about half a century ago, as this insured a comparatively good separation of iridium and of some associated metals, when the recovered rich lead was subsequently skimmed. The only flux used was fluorspar, which insured the rich gold residues remaining in easily fusible condition on the hearth.

Raw Products Required for the Smelting—At the start, the rich gold residues are finely ground in pan mills, accurately sampled, and assayed. Most residues contain appreciable copper and some lead, together with varying quantities of sulphur. A test is usually made to ascertain how much matte will be formed, by fusing a small sample with pyrites, sodium sulphide, or some other sulphur addition. This indicates how much sulphur is necessary to produce the desired matte. In other instances, as a sufficiency of sulphur is already present, no further addition is required.

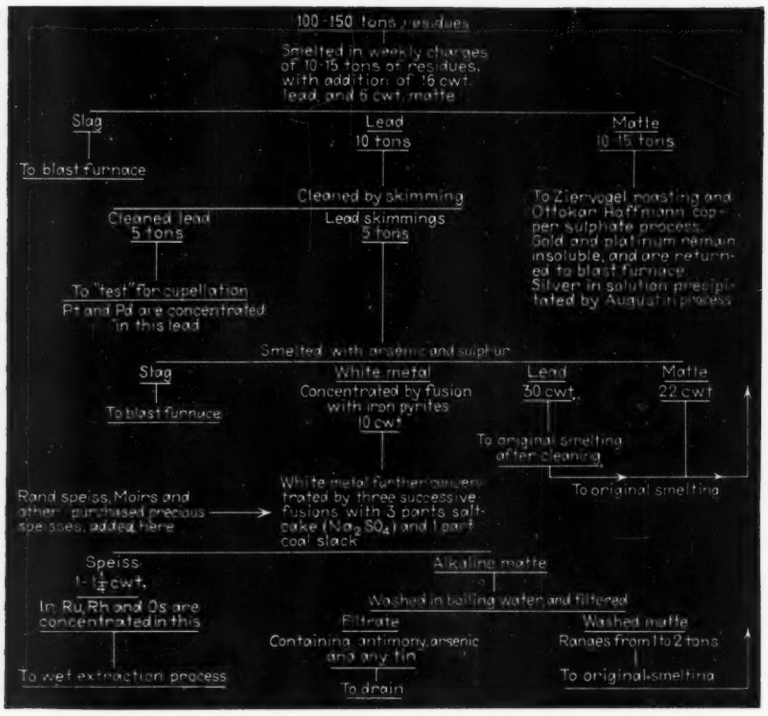
The recovered arsenical lead from the condensing towers is smelted with the litharge which is the byproduct from the "test" or cupellation furnace. When this lead is being recovered, any odd lot of poor residues on hand may be included. This preliminary smelting to give arsenical lead is carried out in the usual fashion for the recovery of lead from lead sulphate; that is, adding the necessary proportion of carbon as coal dross, and reducing the lead by addition of scrap iron.

Products of this treatment include a poor slag, but one which usually contains sufficient silver to justify transferring to the blast surface; that is about 70 oz. of silver per ton, minimum. The matte produced contains from 400 to 500 oz. of silver, 4 oz. of gold, and about 1 oz. of platinum, per ton. It is this matte which is used for adding to the rich residues when they are first smelted.

The recovered lead contains 800 to 1,400 oz. of silver and 20 oz. of gold per ton, but seldom appreciable platinum. This lead is tapped into ingot molds and used for picking up gold from the rich gold residues. Another smaller source of a similar class of lead is the lead recovered from the "test" or cupellation furnace. In this, the products are a rich gold-silver alloy, which is cast into anode plates for subsequent electrolysis by the Balbach-Thum or Moebius process, and litharge, which is sweated on a liquation hearth, giving a lead containing 100 to 400 oz. of silver and about 1 oz. of gold per ton.

Ingots of these recovered leads are placed on the bottom of the reverberatory hearth, together with the poorer recovered mattes. In one week's working, some 10 to 15 tons of rich gold residues is smelted with 16 British hundredweight (one British hundredweight equals 112 lb.) of recovered lead and 6 hundredweight of poor matte. As sulphur additions have been made to the residues, or, alternatively, sulphur is already present, the products from the smelting increase correspondingly in weight. That is, the lead produced, containing practically the whole of the gold and much silver, will amount to 1 ton in weight; the matte may be anything from ½ to 1 ton.

The reason for this variation in the weight of matte is that, no general smelting principles being considered, in the haste to recover the gold the matte may be reduced or oxidized; that is, it may increase its weight from the slag contents, or may be oxidized, whereby more of the base metals may pass into the slag. This very rich lead is not always assayed at this point, as it has to be cleaned


100-150 tons residues
Smelted in weekly charges of 10-15 tons of residues, with addition of 16 cwt. lead and 6 cwt. matte
Slag
Lead 10 tons
Matte 10-15 tons
To blast furnace
Cleaned by skimming
To Ziervogel roasting and Ottokar Hoffmann copper sulphate process. Gold and platinum remain insoluble, and are returned to blast furnace. Silver in solution precipitated by Augustin process
Cleaned lead 5 tons
Lead skimmings 5 tons
To "test" for cupellation. Pt and Pd are concentrated in this lead
Smelted with arsenic and sulphur
Slag
White metal Concentrated by fusion with iron pyrites 10 cwt.
Lead 30 cwt.
Matte 22 cwt.
To blast furnace
To original smelting after cleaning
To original smelting
Rand speiss, Moirs and other purchased precious speisses, added here
White metal further concentrated by three successive fusions with 3 parts salt-cake (Na_2SO_4) and 1 part coal slack
Speiss 1-1½ cwt. In Ru, Rh and Os are concentrated in this
Alkaline matte
Washed in boiling water and filtered
Filtrate Containing antimony, arsenic and any tin
Washed matte Ranges from 1 to 2 tons
To wet extraction process
To drain
To original smelting

RICH GOLD RESIDUES are commonly smelted in reverberatories in Great Britain according to this flowsheet. Simple plant and common labor are sufficient. The abbreviation for hundredweight—"cwt"—denotes the British unit of 112 lb.

by skimming, after which it contains from 4,000 to 7,000 oz. of silver, 240 to 300 oz. of gold, 20 oz. of platinum, and 1 oz. of palladium, per ton. The silver content ranges from 12 to 20 per cent. The matte produced contains 1,800 oz. of silver, 15 oz. of gold, 4 oz. of platinum, and occasionally 1 oz. of palladium and 1 oz. of iridium per ton. The slag contains 100 oz. of silver, 12 oz. of gold, and up to 6 oz. of platinum. This high platinum figure should be taken with reserve, and also the high gold content, as it reflects unfavorably on the system of smelting, but the weight of slag varies too widely for a good criterion of this section to be formed, and all slag is dispatched to the blast furnace to recover the metal values.

A survey of these figures will reveal that the lead contains the vast bulk of the gold, and even where the tonnage of lead and matte may be similar, the proportion of gold passing to the matte seldom exceeds 5 per cent of the total present. Even with careless working, the lead should have absorbed well over 90 per cent of the gold present. When properly worked, the same should be said of platinum and the platinum metals. That is, the lead acts as the "picking-up" agent. What gold and platinum have passed into the matte are not expected to be too appreciable, although they well repay recovery.

The smelting is conducted on an ordinary coal-fired reverberatory furnace, either assisted by natural draft, or the forced draft from a fan, using a water seal, at the fire-grate end.

It is no exaggeration to remark that the furnaces employed at the present moment in Great Britain for smelting gold residues are little different in design from those used more than a century ago. Modern furnace designs and equipment are eschewed, as also are modern fume-recovery plants. The reason for this anomalous condition is that the precious-metal smelters rely on the ancient principle that upwards of 90 per cent of the gold content and about a similar percentage of the platinum metals are absorbed by the lead. Large mining enterprises abroad, however, utilize the latest designs of furnaces, and electrostatic precipitators, for fume recovery, and are so equipped that most of the byproducts may be placed on the market in pure metallic condition.

So far as operating the hearths is concerned, the rich residues are simply charged with periodical additions of fluorspar and scrap iron. The fluorspar maintains fluidity of the mass, and scrap iron is added to precipitate lead from the matte and thus reduces any gold present. Molten slag is skimmed periodically and fresh residues are charged. The enriched lead is tapped into ingot molds about two or three times per week. The matte is allowed to accumulate and is run off at the end of the week.

The matte weathers for a few days to insure easy grinding, after which it is pulverized and roasted according to the Ziervogel system, and the silver and gold contained are separated by wet process, making use of the Augustin silver precipitation method, and conversion of copper to copper sulphate by the Ottokar Hofmann process.

Cleaning Arsenical Lead—The rich lead is cleaned by skimming in the usual manner adopted by lead smelters. The result of skimming arsenical lead is that the larger proportions of the iridium and associated metals are scraped off the surface, as pointed out by D'Hennin. Owing to careless working, osmium frequently is allowed to sink to the bed of the hearths and is not recovered until vacation periods. The bulk of the platinum and palladium remains in the lead. No skill is necessary in skimming the lead, and the air is simply allowed to flow over the surface of the exposed metal, at low temperatures, and then higher degrees, to insure that all antimony and tin, besides copper and iron, are removed.

None of the modern processes of making a clean separation of skimmings from metal are attempted, and the most haphazard methods are used. On several occasions, the tonnage of skimmings removed was practically as great as the weight of cleaned lead left in the bath, although the impurities present did not justify more than a small fraction of this being recovered.

The cleaned lead is tapped into ingot molds, and directly transferred to the "test." When cupelled in the usual manner, the product is an alloy containing 80 to 95 per cent of silver, 5 to 20 per cent of gold, anything up to 1 per cent of platinum, and about 0.1 per cent of palladium. This is simply dealt with by one or other of the electrolytic systems, whereby silver is recovered as pure silver deposit, and the gold, platinum, and palladium as the insoluble anode residue. This completes the process so far as smelting out the rich gold contents is concerned. Smelting of the residues usually takes a week. The resulting lead requires about two days' work to clean, and the cupellation on the "test," because of its small capacity, also occupies the best part of two days. That the process is particularly rapid cannot be claimed, as when large proportions of iridium and its associated metals are present, these pass off to be treated by other methods, and hence the system only satisfies for gold alone, and leaves the other metals at a disadvantage. This system is used in Great Britain at the present time.

Smelting the Skimmings to White Metal—The lead skimmings vary somewhat widely in composition, as a result of the impurities present. So

far as base metals are concerned, these range between the following limits: 40 to 50 per cent lead, 4 to 10 per cent copper, 1 to 6 per cent antimony, 2 to 12 per cent iron, 1 to 4 per cent nickel, 0.5 to 1 per cent arsenic, and occasionally 1 to 2 per cent zinc.

The precious-metal contents average 1,400 oz. of silver, 130 oz. of gold, 45 oz. of platinum, and 2 oz. of iridium per ton.

The varying proportions of copper and antimony reflect on the composition of the raw material. Though these are removed to some extent by atmospheric oxidation, better results are secured by judicious addition of sulphur to reduce the copper, and litharge to oxidize the antimony, following ordinary lead-smelting practice. The process is not suited where excessive nickel is present in the raw materials, and firms engaged on the foregoing work have no option but to refuse consignments when this metal amounts to more than a few per cent.

Skimmings from the lead are mixed with a small proportion of sulphur, arsenic, and coal dross. Where possible, any pyrites containing precious metal are used as the sulphur addition. This also applies with the arsenic addition. Almost any material containing sulphur and arsenic will suffice, as these elements are readily reduced to form a matte and a white metal. The arsenic is sometimes secured as sludge or slimes from nickel works. Each ton of skimmings is mixed with about 1 British hundredweight of pyrites, 4 to 5 hundredweight of slimes containing some 15 per cent of arsenic, 1 hundredweight of coal slack, and covered in the furnace with about 2 British hundredweight of siliceous slag. Fluxing conditions have to be arranged so that the arsenic will be combined to the resulting white metal.

The mass is smelted in a reverberatory when the products are slag, matte, white metal, and lead. Slag is skimmed off and transferred to the blast furnace. Lead containing the white metal is tapped into bogies; the matte remains in the furnace and is tapped last. This matte is used for the initial treatment of gold residues.

The tapped lead is allowed to settle in the bogies for a few minutes, letting the white metal rise to the surface, where it is skimmed off with perforated ladles. As the lead remaining contains some arsenic, it is returned to the furnace for the usual lead-cleaning process, after which it is used for the initial treatment of the gold residues. That is, two of the products, the matte and the lead, are returned for use as "picking-up" agents, for gold and silver.

To assist the separation of the matte from the white metal, scrap iron is still resorted to, prior to tapping. Although this system reduces the specific gravity of the upper layer of matte, it pollutes the latter with iron unnecessarily.

Concentrating the White Metal— The mass of white metal contains much lead as a result of the almost unduly excessive method of skimming, so that it has to be returned to the furnace with the addition of more pyrites, or sodium sulphide. In this repeated process, the slag, matte, white metal, and lead are tapped as before, but the separation of the two products last mentioned is done by allowing the mass to settle in long pig molds. The furnace attendant watches the solidification of the white metal, and lifts it from the surface of the mold as a hard cake, the lead remaining molten below. This white metal represents approximately 10 per cent of the weight of the skimmings from the lead-cleaning process, and concentrates the precious metals in this manner. Comparatively little or no precious metal passes into the slag, matte, or lead, as the arsenic maintains them in the white metal.

By comparing the resulting analysis with that of the skimmings, the nature of the concentration will be revealed. The white metal contains 8 to 16 per cent lead, 10 to 20 per cent copper, 6 to 10 per cent antimony, 10 to 20 per cent iron, 8 to 20 per cent arsenic, and 15 to 25 per cent nickel. The sulphur content varies from 14 to 20 per cent.

As regards the precious-metal contents, these average 1,220 oz. of silver, 150 oz. of gold, 80 oz. of platinum, 90 oz. of iridium, up to 7 oz. of ruthenium, up to 4 oz. of rhodium (and occasionally 4 oz. of palladium), per ton.

In surveying the result of this work, it will be at once apparent that the percentages of nickel and arsenic have been considerably increased. Should it happen that too little nickel is present, there is no option but to add some nickel sludge deliberately.

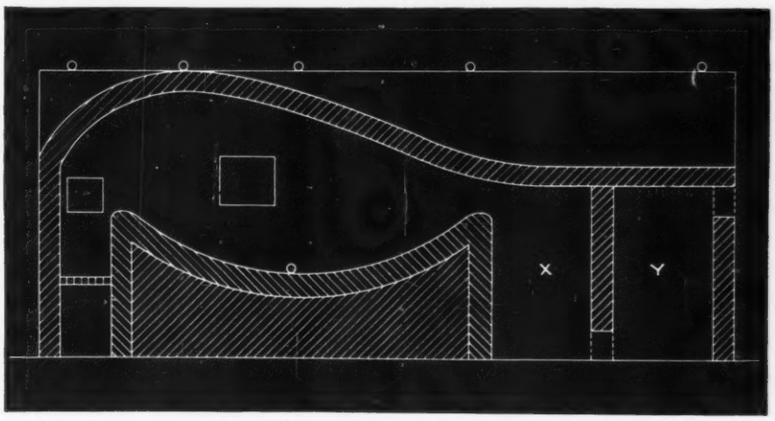
The effect of concentrating the nickel arsenide in the white metal is that the platinum metals have been collected in appreciably reduced bulk, and the most noteworthy of these is the iridium. The original lead skimmings contain so little ruthenium and rhodium that it is scarcely worth while to attempt their assay, except as a crude confirmation.

In view of the reduced bulk of the white metal, it will be noted that the gold has really been reduced, and this is more pronounced when the white metal is properly sulphurized.

It should be added here, that in the blast smelting of the poorer class of gold residues and "sweep," a material similar to the white metal abounds in the form of "pot bottoms." This is really white metal, which sinks to the bottom of the ladles when the matte is tapped. On pouring the matte into molds, this skin, or "pot bottom," remains adhering to the iron of the pot. These "pot bottoms" are mixed with sulphur and arsenic as is done with the lead skimmings, and added to the foregoing products, when the same concentration of the precious metals in the white metal is secured. A slight exception exists, in that the product from the blast furnace is poorer, and hence makes it possible to separate the white metal in still smaller proportion.

Converting the White Metal to Speiss— The white metal is next concentrated to a speiss by repeated sulphurizing. By so doing, the base metals are largely separated from the nickel arsenide, which retains practically the whole of the platinum metals in concentrated condition.

The white metal is first broken to small lumps, and then ground fine. This grinding is essential to insure easy combination of the sulphur with the base metals and the gold. Crude



WHITE METAL produced from lead skimmings is concentrated in a furnace of this design. The bowl-shaped hearth is lined with aluminous brick to withstand corrosion by alkali. "X" and "Y" are settling chambers wherein solid particles, blown over, are allowed to collect. The small fireplace and restricted draft caused by the use of settling chambers give the required dull red heat

salt cake, or sodium sulphate, is weighed off in the proportion of three times that of the white metal, and a proportion, equivalent to that of the white metal, or coal slack is also weighed off. The mixture, represented by one part white metal, three parts salt cake, and one part coal slack, is thoroughly ground and mixed together. It is then charged to a small reverberatory furnace, which is well lined with highly aluminous brick. If good aluminous bricks are not used, the lining will become unduly corroded by the molten alkaline mass, and the risk arises of the very rich speiss partly sinking into the hearth. Because of the rich nature of the product, the lining is removed periodically, broken up, and charged into the blast furnace to recover any rich metal values.

Reverberatory Coal-fired

The small reverberatory furnace is coal-fired, and the flue end is equipped with a small chamber wherein the excess salt cake, which has been evolved by the heat, is given the opportunity to settle out. A dull red heat is all that is required.

The mixed mass is shoveled on to the hearth, and begins to swell up as the carbon reacts with the salt cake, converting it to sodium sulphide. The process is continued with periodical mixing until the surface shows itself to be tranquil. After settling, the enriched white metal is tapped into pot molds, allowing a certain amount of the alkaline sulphide mass to follow it, to insure that all of it has been recovered.

On solidifying, the enriched white metal is obtained as one hard cake. The fluid mass of alkaline sulphide, which has extracted much of the gold present, is run off into pot molds, and thence left to weather prior to wet treatment. This enriched white metal is ground, mixed with the same proportions of salt cake and coal slack, and the foregoing process repeated. It is usually necessary to repeat it a third time, to insure reduction of the white metal to almost pure speiss.

The following figures will indicate how the reduction in weight occurs: 58 British hundredweight of white metal was reduced to 20 hundredweight by the first treatment with salt cake and coal dross. The second treatment reduced this to 11½ British hundredweight, and the third treatment reduced it to 7 British hundredweight. By means of judicious handling of the base-metal contents, it should not have been necessary to repeat the process the third time, but as the costs were trifling compared to those of the valuable platinum metals, economical measures were not considered at this point.

The action of the sulphur of the salt cake is to remove practically all the base metals, and also the vast bulk of the gold and silver from the white metal.

As a general rule, the white metal is reduced to from 12 to 15 per cent of its original weight, and is now, properly speaking, a nickel speiss.

The following analysis will reveal the composition of this concentrated speiss: 50 to 59 per cent nickel, 5 to 20 per cent arsenic, 0.5 to 5 per cent antimony, 0.5 to 4 per cent copper, 1 to 2.3 per cent iron, and traces up to 1.0 per cent lead. To this must be added varying percentages of sulphur, but no other base metals. It is thus by no means a pure speiss, but does the work of concentrating the platinum metals and causing the gold to pass into the light alkaline matte.

As regards the precious constituents, these have been concentrated as follows. Nil up to 200 oz. of silver, 80 oz. of gold, 500 oz. platinum, 940 oz. of iridium, 240 oz. of ruthenium, about 4 oz. of rhodium, nil up to 200 oz. of osmium, and with bought speiss, up to 40 oz. of palladium per ton.

This completes the smelting section of the work, and many tons of skimmings from the cleaning of arsenical lead are collected, and concentrated to these few hundredweights of speiss. Probably the majority of these precious metals are secured from the raw materials without any charge being made for them, as they exist in such small quantities. There is, of course, bought speiss principally obtained from the Rand mines, sometimes known as Moir's speiss, and other varieties from different parts of the world. All such speiss is subjected to this treatment with salt cake and coal slack, to concentrate it.

The alkaline sulphide matte is of considerable bulk, as it is of low specific gravity. When the mixture charged amounts to 5 tons per week of smelting, about 4 tons of this by-product is obtained. It contains, 10 to 20 per cent iron, 8 to 22 per cent copper, 6 to 8 per cent lead, 1 to 3 per cent antimony, any tin present, and a varying small proportion of nickel. As regards precious metals, it contains 200 to 300 oz. of silver, 20 to 40 oz. of gold, 1 to 2 oz. of platinum, and from 0.3 to 0.5 oz. of iridium per ton. The concentration of the gold in this alkaline sulphide will be apparent at once. What antimony and tin are present are absorbed in this alkaline sulphide, but residues rich in these metals are not specially desired for this process, as they are uneconomically dealt with. This alkaline sulphide, or "top matte," is ground and boiled in water, whereby antimony, tin and associated metals, which are soluble, are removed. The washed mass is passed over a vacuum filter, allowed to dry in the air, and is used up as a sulphur addition in the initial smelting of gold residues.

The rich speiss is separated into its constituent metals by wet methods similar to those used in the full analysis of precious materials in the laboratory.

Simplicity of Plant Layout—As regards plant layout, the work described requires only two small reverberatory furnaces and a washing tank and filter. For subsequent treatment of the products, the lead containing the gold and silver is cupelled on a "test" hearth, and the rich speiss dealt with in a small, wet extraction plant.

Speiss which accumulates from the Rand mines, South Africa, is disposed of periodically in lots of several hundredweights, and an example of the precious-metal contents is 54 oz. of silver, 88 oz. of gold, 13 oz. of platinum, 50 oz. of iridium, 40 oz. of ruthenium, 83 oz. of osmium, and from nil up to 100 oz. of palladium, per ton. These figures vary widely from time to time. It will be noted in the foregoing example that no rhodium is present. This is one of the richest precious metal raw materials available on the market. Similar by-products accumulate in nickel works and are subsequently dealt with in the same manner.

Where precious metals are smelted, the furnace bottoms are periodically removed, the refractory material is fluxed, and the resulting white metal included in the charges sulphurized by salt cake. These are generally rich in osmium, and although this is a volatile metal, the smelting method is frequently persevered with.

The Process Simple

It is a common misconception that the smelting of precious metals is a complicated matter, largely because of the considerable number of constituents and different figures enumerated. The smelting is really of the simplest possible order, and is conducted by unskilled labor throughout. The process, in short detail, is that when rich gold residues are smelted in the manner described in the foregoing more than 90 per cent of the gold and associated precious metals pass into the lead. On skimming this arsenical lead, most of the platinum metals are separated, and then concentrated to a white metal by further addition of arsenic and sulphur. The white metal is reduced to concentrated speiss by repeated fusion with salt cake and coal slack, which removes the associated base metals and the gold as well.

It should be added that most of the actual platinum and palladium may be allowed to remain in the lead which goes to the "test" for cupellation, whereas the arsenical skimmings contain practically the whole of the iridium, ruthenium, rhodium, and osmium.

Underground Efficiency At the Zeibright Gold Mine

Some recent developments and practices

R. O. Camozzi
General Foreman
Empire Star Mines Company, Ltd.
Grass Valley, Calif.

ECONOMIC EXPLOITATION of an orebody of the marginal type is not always an easy matter. To maintain low operating costs requires constant study of underground conditions and application of mining methods adapted to the size and character of the deposit. In the Zeibright mine of the Empire Star Mines Company, Ltd., situated in the Grass Valley-Nevada City mining district, near Emigrant Gap, Nevada County, Calif., successful mining of a hard, tough, low-grade ore, consisting of a deep-seated dike dipping steeply at 80 deg., varying in width from 4 to 30 ft., and inclosed between slate walls whose bedding planes stand nearly on end with the lode cutting across these planes at a slight angle, required provision of the following necessities: (1) An efficient surface plant and mechanized underground operations wherever possible; (2) high air pressure and good drill steel; (3) control of both blasting and heavy explosive consumption; (4) high unit shift production and standardized balanced attack; (5) ventilation; (6) engineering and drilling skill; and (7) progressive management. How these requirements were satisfactorily met will be related.

Surface Plant and Mechanical Equipment Underground.—The surface plant is conveniently laid out and has modern equipment in every department. Air compressors are of the latest design, with automatic unloaders according to footage demand to take care of variable air consumption with minimum power input. Equipment and materials are handled mechanically whenever possible, tugger hoists set up with skyline action to lift being used for this work. Underground, all timber and steel are moved up raises with these machines. Haulage of ore is done with storage-battery locomotives pulling ten-car trains of 4-ton Granby-type cars over 0.4 per cent grades favoring the loaded car. The main shaft is served by an hydraulic-type Nordberg hoist. Only the fastest rock drills are employed for drifting, raising, sinking, and stoping, the type and make of drill being determined by competitive tests at rock breasts. Recently, a Conway mechanical mucker has been installed.

High Air Pressure and Drill Steel.—To increase drilling speed, a pressure of 105 lb. is maintained at the compressors, so as to assure 100 lb. at the drill-hose coupling underground. The distributing system is of adequate size and contains a minimum of bends and other pipe fixtures. Contrary to general opinion, compressors and rock drills are standing up well under current operating conditions. Improved drilling performance is indicated by the fact that the main heading on the 300 level, requiring a 48-hole round to break 8 ft. in an 8 x 10 ft. cross-section, is drilled and blasted in one 8-hour shift by three miners. This means 384 ft. of drill hole, 50 sets of drill steel and 620 1⅛ x 8-in. sticks of 40 per cent gelatine dynamite per round, which gives an idea of the hardness of the ground.

As to drill steel, a new 1-in. quarter-octagon Swedish steel, containing chromium, carbon, and molybdenum, has been in constant use for more than a year. Fatigue and drilling performance with 3½-in. drills has been remarkable. Only three batches of steel have been cut and made up during this period, the last batch being made up about six months ago. The original steel is still in service, but is now used as starters after a gradual reduction in length from 9 to about 3 ft. with little breakage. Currently, the breakage experienced with this steel is about half of 1 per cent. It occurs mostly near the bit and seldom in the center portion of the drill. The last feature is of considerable importance in stope-hammer drilling. Compared with 1¼-in. round carbon steel of the same age one month after introduction, breakage ratio was 1/10 to 3 per cent, or eight pieces of steel per 8,000 and 75 pieces per 2,500 respectively broken in the short period of the test. It is estimated that with 1¼-in. carbon steel at least three replacements would have been necessary during this time.

The 1-in. quarter-octagon steel is harder to forge than ordinary drill steel. The untempered, air-cooled shanks give excellent wear. Inasmuch as water-tempering destroys the quality of the steel, all drill bits are tempered in oil. It was soon recognized that the extra toughness of the steel and reduced gage wear, which were probably due to the chromium content, permitted an increase in drill change from 18 to 24 in. and a reduction in gage variations between changes. As a result, a slightly tapered, sharp-faced, fast-cutting bit with rapid sludge discharge was evolved and adopted. Bit sizes on the starters, seconds, thirds, and finishers are 1⅞ in., 1¾ in., 1⅝ in., and 1½ in., and the drill lengths are 3 ft., 5 ft., 7 ft., and 9 ft. Advantages and economies thus derived are obvious. To fit this drill change, the stoper machines were equipped with longer legs built by the manufacturer. When extended the machines measure 9 ft., and the miners had little trouble once they got used to them.

Blasting.—All blasting in the mine is done by electric detonators and 40 per cent gelatine dynamite. A two-conductor, No. 12 wire, tellurium-compound-coated cable using a potential of 440 volts delivers electric current close to all blasting faces. Up to 13 delays are used, and for rounds of not more than 30 holes a series circuit is made. For blasting rounds containing 60 or less holes, two series groups are connected in parallel, and a graded series-in-parallel circuit is used for rounds with more than 60 holes. Final connection of rounds to the blasting cable and throwing of the switch is done by the shift boss, who also checks all circuits by galvanometer before firing.

High Unit Shift Production and Standardized Balanced Attack.—Production, stope preparation, and development crews have a high standard of work required for each man. As will be shown later, operating methods have been standardized to eliminate guesswork on the miner's part. Standardizing work means more supervision when a heavy turnover of labor exists, but with steady crews, as at the Zeibright mine, mining operations soon run smoothly. All men are asked to express grievances freely

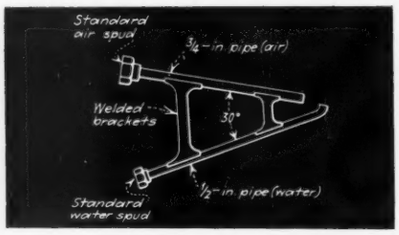


Fig. 1 . . . SPECIAL VAPORIZER, or water blast tool, devised to aid in clearing headings quickly after blasting in raises, chute pockets during their construction, dead-end stopes, drifts, and shafts

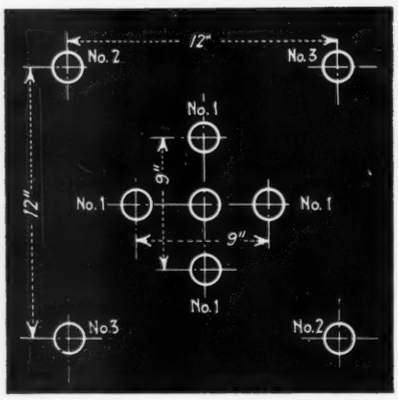


Fig. 2 . . . BURN CUT used for a time in Zeibright mine in the effort to increase depth of round pulled in blasting. All holes are placed symmetrically and drilled 8 ft. deep. Center hole is not loaded. The eight holes blasted open up 144 sq.in. of cavity

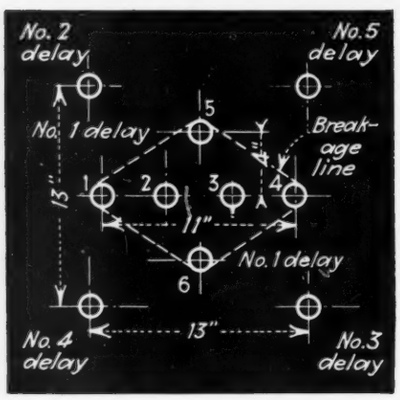


Fig. 3 . . . ZEIBRIGHT SHATTER CUT, devised to avoid liberal use of powder featuring the burn cut (shown in Fig. 2) and frequent consequent damage done to chutes and timbers. All holes are drilled straight in. Those numbered 1 to 4 are not blasted. The other six holes open up 169 sq.in. of cavity

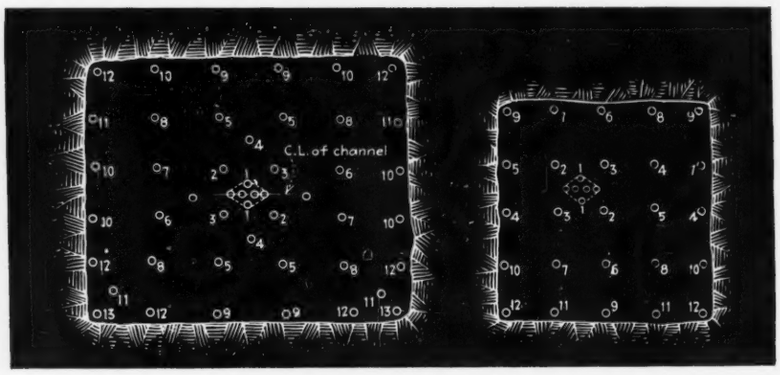
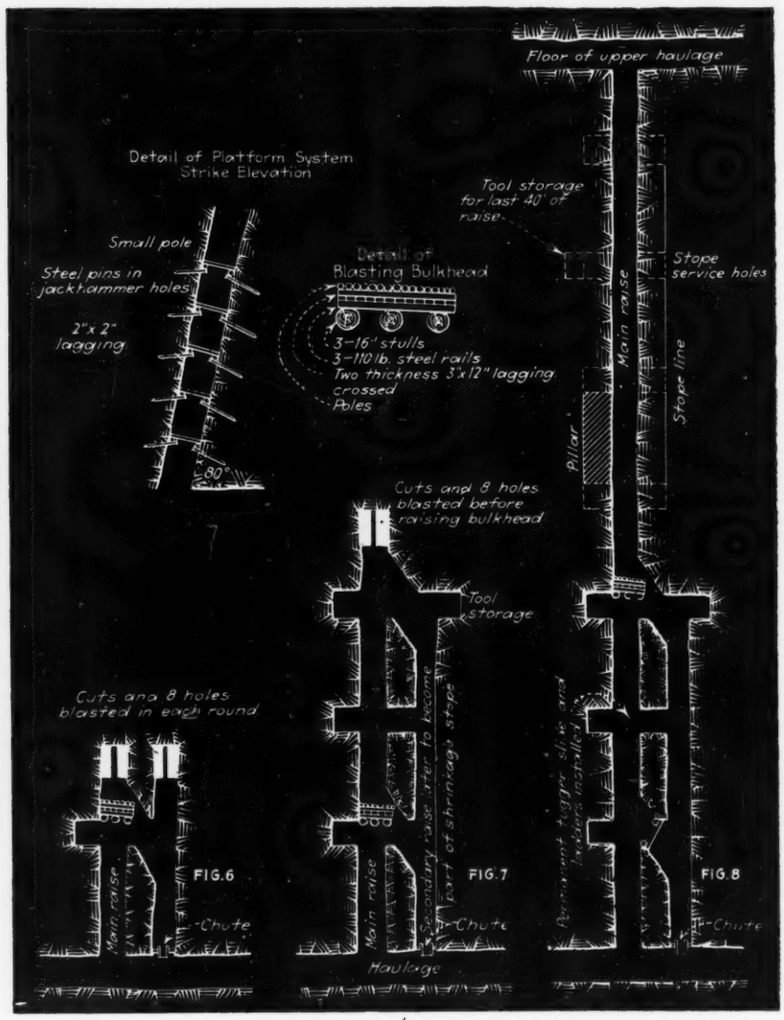


Fig. 4 . . . TYPICAL 48-HOLE ROUND for an 8x10-ft. heading. It calls for the use of 13 delay electric detonators. Note the holes for the shatter cut. Fig. 5 . . . (right) TYPICAL RAISE ROUND for 6 x 6-ft. opening. It has 31 holes and requires 12 delay electric detonators

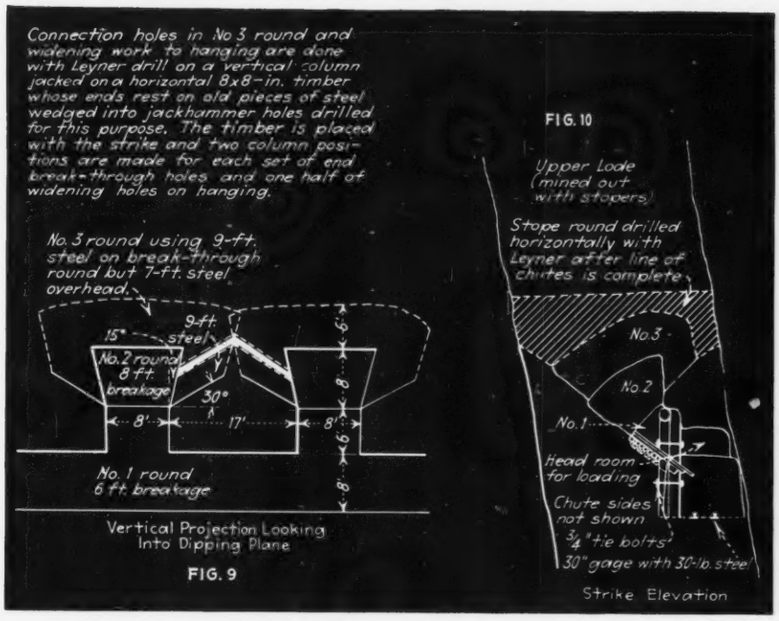


Figs. 6, 7, and 8 . . . THREE STAGES in the operation of driving raises in the Zeibright mine when a 200-ft. interval is used between haulage levels

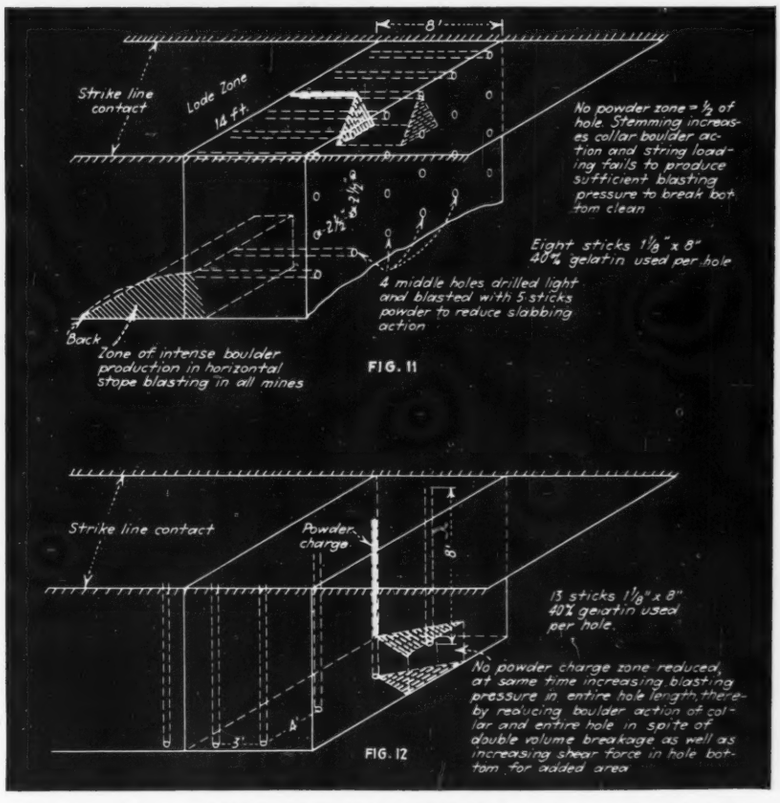
without fear of reprisal, and discussions are open. Worth-while suggestions are credited to those making them, and are rewarded.

To lay out work properly in chute construction, chute pocket driving, working out blind distances, and other auxiliary underground work, a simplified system of surveying was developed. It incorporates the use of a combination Lufkin 2 ft. clinometer rule with level and a 50 ft. tape, as well as mental knowledge of sines and cosines from 1 deg. to 90 deg., up to 2 decimals. In cases where shift bosses find it difficult to remember these figures, a two-page slip of tables is recommended.

Ventilation.—The necessarily heavy charges of explosive call for quick elimination of noxious gases if working efficiency is to be maintained. Development is carried on as far ahead as possible to permit stope preparation and stoping proper in a circulating atmosphere. However, the driving of main headings to a length of 2,000 ft., and raises from 200 to 300 ft. in height, requires special ventilation, and although tube ventilation is possible in the main headings in spite of its cost, it is impracticable in small raises. Assuming that CO,


Connection holes in No 3 round and widening work to hanging are done with Leyner drill on a vertical column jacked on a horizontal 8x8-in. timber whose ends rest on old pieces of steel wedged into jackhammer holes drilled for this purpose. The timber is placed with the strike and two column positions are made for each set of end break-through holes and one half of widening holes on hanging.
No. 3 round using 9-ft. steel on break-through round but 7-ft. steel overhead.
9-ft. steel
15°
No. 2 round 8 ft. breakage
30°
8'
17'
6'
No. 1 round 6 ft. breakage
Vertical Projection Looking Into Dipping Plane
FIG. 9
FIG. 10
Upper Lode (mined out with stopers)
Stope round drilled horizontally with Leyner after line of chutes is complete
No. 3
No. 2
No. 1
Head room for loading
Chute sides not shown
3/4" tie bolts 30" gage with 30-lb. steel
Strike Elevation

Figs. 9 and 10 . . . CONSTRUCTION OF CHUTES on 25-ft. centers in the course of stope preparation. Connecting holes in No. 3 round and widening to hanging are done with Leyner drill on vertical column, jacked on horizontal 8x8-in. timber and whose ends rest on old pieces of steel wedged into jackhammer holes drilled for the purpose. Timber is placed with strike, and two column positions are made for each set of end break-through holes and one half of widening holes on hanging


8'
Strike line contact
Lode Zone 14 ft.
No powder zone = ½ of hole. Stemming increases collar boulder action and string loading fails to produce sufficient blasting pressure to break bottom clean
Eight sticks 1⅛" x 8" 40% gelatin used per hole
4 middle holes drilled light and blasted with 5 sticks powder to reduce slabbing action
Back
Zone of intense boulder production in horizontal stope blasting in all mines
FIG. 11
Strike line contact
Powder charge
8'
13 sticks 1⅛" x 8" 40% gelatin used per hole.
No powder charge zone reduced, at same time increasing blasting pressure in entire hole length, thereby reducing boulder action of collar and entire hole in spite of double volume breakage as well as increasing shear force in hole bottom for added area
3'
FIG. 12

Figs. 11 and 12 . . . COMPARATIVE STOPE BREAKAGE with horizontal round drilled by machine on vertical column (Fig. 11, above), and with vertical stoper round (Fig. 12), as illustrated by these sketches, was studied. With the horizontal round there is a heavy production of boulders. These have given but little trouble with the vertical round, which has been adopted for all stope work

SO_2, CO_2, and NO_2 gases form the bulk of noxious explosion products, and studying the following physical volumetric properties—namely, that 3.5 parts of CO are absorbed by 100 parts of water at O deg. C.; 7,979 parts of SO_2; 179 parts of CO_2; and some NO_2—it was decided to design a special vaporizer. The simple device is illustrated in Fig. 1. It produces without difficulty the large water surface or fog condition necessary for rapid absorption. In deep and hot mines the high humidity thus produced would be a disadvantage.

The vaporizer is fitted with standard air and water connections so that the hoses taken from a drill set-up can be attached to it. The water tube is made from ½-in. pipe and the air tube from ¾-in. pipe. Both are held together by two brackets. It is used in raises, chute pockets under construction, dead-end stopes, drifts, and shafts. In dead-end stopes normal air conditions were restored in one-fourth the time required for compressed air alone to clear the fumes. Long raises can readily be approached 45 min. after blasting. Where there is danger of flying rock damaging the end of pipe lines, as for instance in headings and shafts, water must be injected into the air line some distance back from the face or bottom of the shaft, the pressure of the water exceeding that of the air at the point of injection. In gassy dead ends where men found that early shift conditions were unsatisfactory, proper use of the vaporizer entirely eliminated all difficulties.

Engineering and Drilling Skill.—Closely supervised experiments carried on a year ago proved that conventional V-cut or toe-cut rounds in the lode proper rarely broke clean, and advancement of the face more than 4 ft. was found difficult. The pyramid cut pulled well in large faces, but proved impracticable in small section. Besides, expert miners were required to place the holes. These factors indicate slow and costly development in drifts, and more especially in raises and connecting pillar-type chute pockets for the shrinkage system of stoping employed at present. An attempt was made to lengthen rounds by using the "burn-out" cut shown in Fig. 2. Eight-foot holes were drilled, and to pull the ground successfully a 4½ in. distance between holes was used, with the center hole left unloaded and four holes, marked **No. 1 delay**, each containing 20 1⅛ x 8 in. sticks of 40 per cent gelatin dynamite. This round continued to break satisfactorily, but at times completely demolished large shrinkage chutes and raise bulkheads, especially when the holes marked No. 1 delay and an odd reliever in the holes marked No. 2 and No. 3 delay exploded simultaneously. This meant a blast that employed 100 sticks of dynamite.

To avoid such liberal use of explosives and the consequent demolition of timber, the Zeibright shatter cut shown in Fig. 3 was evolved. This cut incorporates the channel cut idea developed in Switzerland many years ago when labor and power were cheap but powder was expensive. All holes are drilled in straight from the breast,

with the breast advanced at any angle from drifts to vertical raises. The line of holes 1 to 4 is never blasted, and Nos. 5 and 6 are merely "side-swiped" to the channel formed by these holes. Chutes withstood successfully the two-hole concussion made by this cut, provided the holes were not pointed directly at timber. When properly drilled, the performance of this round is so positive that it is unnecessary to blast cuts individually unless for reasons other than non-breakage.

Typical rounds for headings and raises are explained in Figs. 4 and 5. The depth of round that can be broken is limited only by the length of steel which can be handled in a practical manner. At the Zeibright mine this is 9 ft. For the past year rounds drilled with 9 ft. steel have been broken to depths of 7 and 8 ft. in chute pockets, drifts, crosscuts, and raises with a considerable reduction in costs. Exceptionally hard ground can be broken satisfactorily by lengthening the channel and adding two cut holes parallel to the channel.

Cost of Raising Lowered

Raise costs in particular were reduced by the use of this round, and at present the footage made by four men is three times that ordinarily obtained by the same number of men with the old stull-type manway raise. To do this another idea had to be incorporated, and the progress of the work is shown in Figs. 6, 7, and 8. The procedure applies to 200 ft. haulage intervals. Greater distances call for further addition of bulkhead placements until the last 75 to 100 ft. is reached, which is driven in one lift.

The first lift of 40 to 50 ft. is blasted down into the haulage continuously and rigging up is done on the rock pile until miners can barely squeeze through with equipment. This round contains two additional down-pointing holes drilled in both hanging wall and footwall at intervals of 6 ft. with a jackhammer. The two raise rounds are then blasted, and the haulage is cleared in one 8-hour shift by a Conway mechanical mucker. Rigging up starts with the placing of short discarded starter drills in the two holes in the footwall and hanging wall. Two light poles are laid on these drills and two to three short 2 x 12-in. lagging placed on the poles to form a platform. The self-locking platforms are continued upward until a distance of 9 ft. from the back is reached. Next, the drilling equipment and steel are hoisted up, the rounds are drilled out and loaded, and the electrical blasting system is adjusted, and downward systematic removal of platforms is followed by blasting. This operation is repeated until a determined point is reached where drift rounds and over-pass rounds are blasted. A chute is then built in the secondary raise. Permanent platforms, offset ladders, and hoisting slide are erected up to the bulkhead site, followed by actual construction of the bulkhead shown. The purpose for using 110-lb. steel rails is both to strengthen the bulkhead and to distribute uniformly the blasting concussions. Subsequent procedure is explained in Figs. 6, 7, and 8.

The shatter-cut round speeded up, cheapened, and standardized the construction of chutes on 25 ft. centers (see Figs. 9 and 10). The first round is drilled with 7 ft. finishers and blasted onto the track. A new set-up is then made on the resulting rock pile, and the next round is drilled with 9 ft. finishers with a 15-deg. wing action on square-up holes. These two rounds completely fill a haulage 8 x 10 ft. in cross-section. Conventional practice is to blast down three such pockets and rapidly remove the broken material with a Conway mechanical mucker. Holes are then drilled horizontally on opposite strike faces of the first round 2 ft. vertically below the breakage back of the first round with jackhammers, and short waste drills are placed in them. Next, an 8 x 8 in. timber is laid on these drills and rigidly wedged, followed by mounting of an 8-ft. column on this timber 2 ft. from one connection face and blocking it to the roof. The 8 x 8 in. timber also acts as a platform foundation with the aid of a second stull. The connection round shown in Figs. 9 and 10 is drilled out, a set-up made on the other side, and this face is drilled, while the back is drilled out with a long-barrel stoper. Only the cuts and eight relievers are blasted in the connection round, all remaining holes being blasted into the constructed chute. Oregon pine measuring 18 in. is used for chute posts.

As successful production in mines of the Zeibright type depends to a large extent on proper stope breakage, a careful study was given this phase of mine operation. The final conclusion reached was that horizontal breakage was a failure unless a secondary breakage chamber commonly known as the bulldoze chamber or grizzly level was used. For several reasons, including the peculiar geometrical outlines of the lode, use of a grizzly level was out of the question. On the other hand, without this level, instead of a train crew of three men tramming on the average 200 tons of ore to the mill from shrinkage chutes in 8 hours, boulder action in spite of extremely fatiguing effort permitted at times only 50 tons to be moved to the surface. Referring to Fig. 11, besides the heavy production of boulders in mines employing horizontal breakage caused by the prying action of bottom holes on the long open back and the collar action resulting from long holes, strike joints or faults common to the lode often caused bottom holes to break slabs 12 ft. long and up to 3 ft. thick.

Horizontal Breakage a Failure

Since success of shrinkage mining is so closely linked to control of "swell draft" in stopes, so that maximum working time may exist for miners and all linking labor, the horizontal system of breakage was a complete failure. Introduction of better and faster stoper machines resulted in the exclusive use of self-rotating stopers for stope breakage. Fig. 12 shows that the prying boulder action of the horizontal round in Fig. 11 is entirely eliminated in the stoper round. Theoretically, each row of holes in Fig. 12 has some breakage performance and must break off the solid back. Now, if eight $1\frac{1}{8}$ x 8 in. sticks of dynamite fill an 8 ft. hole only half full and are required to produce a blasting pressure of sufficient margin to shear an area $2\frac{1}{2}$x$2\frac{1}{2}$ ft. at the bottom of the hole, it is evident that if a few cartridges of dynamite are added to those in the hole, boulder action near the collar of the hole is reduced and the pressure in the hole increased accordingly. This means greater shear force, and by using 13 sticks of dynamite it was reasoned that holes could be spaced on 4 ft. centers in the rows, with the rows 3 ft. apart. As the depth of the hole in both rounds is identical, the volume or tonnage varies as do the face areas, or, according to the following examples: $2\frac{1}{2}$ ft. by $2\frac{1}{2}$ ft. equals 6.25 sq.ft. and 3 ft. by 4 ft. equals 12 ft. per machine. Breakage is almost doubled with the same number of holes.

The theoretical round was employed and proved so successful that it was adopted for all stope work. Breakage checks closely with the figures given. As a consequence, boulder action was reduced to an extent that little or no difficulty is experienced in controlling stopes. These measure 400 ft. between working raises, with a cut made in the center and two sets of miners receding toward each raise with overhead benches. An additional advantage is that the scattering action of each hole throws boulders out into the open, where they can be blockholed to assist chute draft. Men coming on shift generally can commence work at once even if the round broken previously has not been drafted down, and besides can always blast.

I wish to thank the management for permission to publish this article. To John Becker I am indebted for the idea of the 2 ft. steel change in hard rock in which advantage of improved metallurgy of steel was taken, and the initial idea of the possibility of driving a double system of raises.

Blast-Hole Drilling At the Tilden Pit

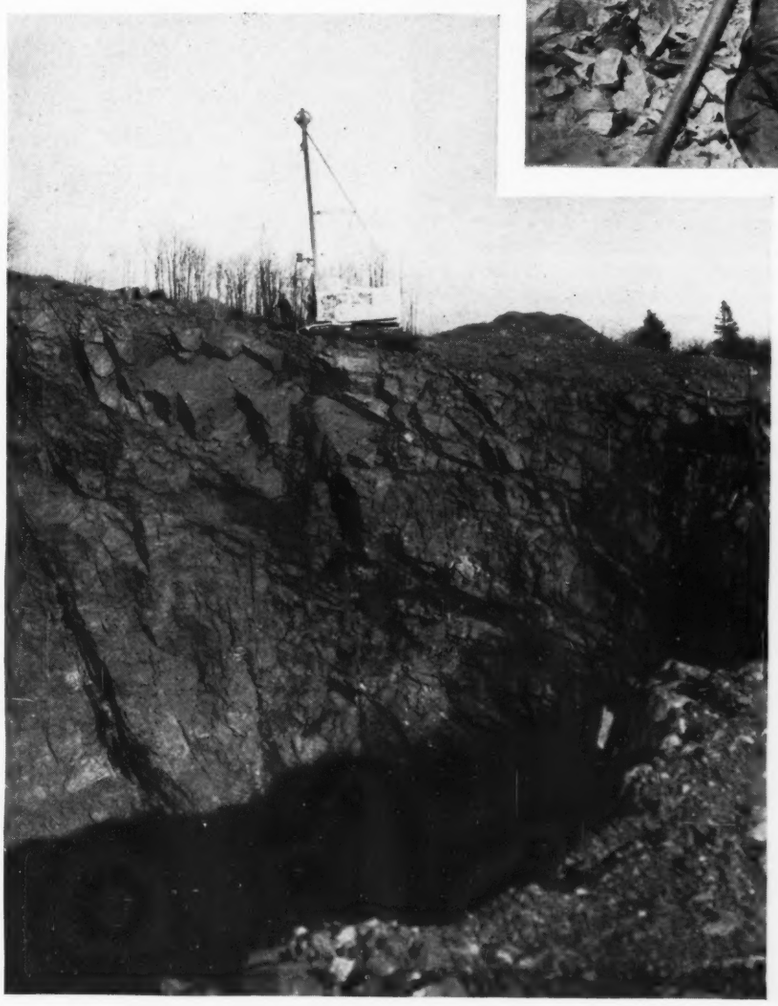
Substitution of 9-in. churn drills for 6-in. machines reduces cost 26c. per foot

BLAST - HOLE DRILLING practice at the Tilden open-pit iron-ore mine of the Cleveland-Cliffs Iron Company, on the Marquette range in northern Michigan, appears to have been much improved since the latter part of the 1936 season by the substitution of churn drills capable of drilling holes 9 in. in diameter for the drills previously in use that put down 6-in. holes. Two 9-in. drills are in service. From the time the change was made last fall up to the first of August, 1937, the footage of 9-in. hole drilled totaled 2,784. Operating cost per foot, this being exclusive of depreciation, interest, and any overhead, was $1.69. This is 13.3 per cent less than the corresponding operating cost, averaged for a three-year period, of drilling 23,960 ft. of 6-in. hole, which was $1.95 per foot. Admittedly, the periods of comparison are widely different in length, and the figures are to be taken with this in mind. Nevertheless, if 2,784 ft. of 9-in. hole can be drilled for 26c. a foot less than any footage of 6-in. hole, the result should command the attention of operating men.

The following figures, moreover, will serve to continue the comparison: The average burden per foot of length of hole was 600 cu.ft., or 44.5 tons, for the 2,784 ft. of 9-in. hole, and only 330 cu.ft., or 24.4 tons, for the 23,960 ft. of 6-in. hole. This is an increase of 82 per cent in both volume and tonnage in favor of the 9-in.

LOADING A HOLE. A hook on the end of the hoisting rope engages in a loop of the cord tied around the stick of powder. When the latter reaches the bottom, a jerk on the rope causes the sharp inner surface of the hook to cut the cord

IN THE TILDEN MINE. One of the 9-in. Bucyrus-Armstrong units at work in the East pit



hole. Drilling cost per ton for the 9-in. hole is $0.038, against $0.08 for the 6-in. hole, a decrease of 52½ per cent in favor of the 9-in. hole.

Speed of drilling also appears to favor the 9-in. drill, 2,365 ft. of hole having been put down at a rate of 15.6 ft. per 8-hour shift, as compared with a rate of 13.7 ft. per 8-hour shift for 2,746 ft. of 6-in. hole. The gain here is approximately 14 per cent in favor of the larger drill.

Average depth of these holes is about 100 ft. The 9-in. holes are spaced 20 ft. apart in the row, the latter being 30 ft. back from the position of the row previously fired, whereas the 6-in. holes were spaced 15 ft. apart in a row 22 ft. from the previous row. To insure that the row of holes next to be drilled after the row along the face is blasted will be at the standard distance of 30 ft. (in the case of 9-in. holes) from the first row, the position of the second row is marked by a red line on the surface before the first row is blasted. Thus no matter how the holes in the first row break, the succeeding row nevertheless can be drilled on the line previously determined. The individual holes in the second row are spotted midway between the center lines of the holes of the previous row blasted. That is, the holes in successive rows are staggered. Holes are also drilled 5 to 6 (usually 5) ft. below the grade of the bottom of the pit. By these means the possibility otherwise of leaving a toe of unbroken ore on the pit bottom, which tends to lengthen and become a ridge that must be climbed over, is avoided.

Heavier Tools More Effective

Two 9-in. drills are in service, both of them 29T Bucyrus Armstrong units, replacing the 6-in. The string of 9-in. tools of the former drills weighs 2,700 lb., including stem and bit but excluding jars, the latter being considered unnecessary. This is 80 per cent more than the weight of the string of 6-in. tools, jars here being included. Thus with a 9-in. bit one has 300 lb. of weight for every inch of cutting diameter, as compared with 250 lb. per inch with a 6-in. bit. This fact accounts in part for the greater effectiveness of the larger bit.

The capacity of the holes for powder varies as the square of the diameters, or as 81 to 36 for the 9-in. hole with respect to the smaller one. Chambering is not used, save for the use of a stick or two of powder to get the proper clearance when starting a new bit in the bottom of a hole. The holes are deck-loaded with 7½-in. powder for 9-in. holes and 5-in. powder for 6-in. holes. Ninety, 60, and 40 per cent gelatins are used; also some Gelamite. The precise manner of loading depends on the character of the ground. The holes are blasted a row at a time with Cordeau Bickford, this being detonated by cap and fuse in a connecting tube or union. A piece of Cordeau runs the full depth of each hole and at the top is spliced on to another length of Cordeau running on the ground along the row of holes and linking them together so that all can be fired practically at the same time. Total primary blasting yields approximately 3 tons of ore per pound of powder. (Secondary blasting extra.)

Two Grades of Ore

The Tilden mine yields two grades of siliceous ore, one, Tilden Silica, running 38.5 per cent iron natural, 41.4 per cent silica, and 0.037 per cent phosphorus; the other, Tilden Low Phos., running 0.012 to 0.015 per cent phosphorus. This is shipped for certain furnace purposes without grading with ores from other properties. Preparations for mining were begun in 1927. Real production began in 1929. Today there are really two pits—the West, which was the first to be started, and the East, some 800 ft. away—with a crushing plant midway between them. The West pit was started on a sidehill and today has a face about 100 ft. high and 1,200 ft. long. It is served by two electric full-revolving caterpillar-mounted shovels, one a No. 480 E Marion with a 2-cu.yd. dipper, and the other a No. 80 B Bucyrus with a 2½-cu.yd. dipper. These load Easton cars, each having two 10-cu.yd. side-dumping bodies. These cars are hauled by steam dinkey locomotives to the crusher, where the cars are dumped by means of an overhead hook, electrically operated. Each pit has one of the two 9-in. churn drills.

Digging conditions are more difficult in the East pit. Here, instead of attacking on sidehill, the single shovel, which is also a No. 80 B Bucyrus like the one in the other pit, has had to make a cut some 100 ft. wide directly into the ore to start the pit. At present only two cars can be spotted at a time. The work is therefore slow compared with that in the West pit. Certain structural conditions in this pit also presented difficulties in drilling with a 6-in. drill that have not been encountered up to the present with the 9-in. drill.

Ore from the two pits is so mixed as to produce the so-called Tilden Silica grade. About 2,000 tons is being mined daily, working one 8-hour shift. After being crushed the ore is delivered by railroad to the docks at Marquette for shipment by boat to Lower Lake ports.

The crushing plant is on sidehill with its dumping platform on a level with the track running between the pits. Cars are dumped, one body at a time, directly into a 42-in. Traylor Bulldog gyratory, set to crush to 5½ in., which discharges over a grizzly with 2½-in. spacing. Incidentally, the ore is very abrasive. The oversize is divided between two 10-in. fine reduction gyratory crushers, crushing to 2 in. The product of the latter is mixed with the grizzly undersize and sent by conveyor to the railroad shipping pocket.

Crushing is dry, but all dust nuisance has been practically eliminated by a simple yet efficient baghouse. The discharge of the Traylor crusher is housed with corrugated galvanized iron, this housing inclosing the two smaller crushers also. The crusher men wear respirators, although there is practically no dust outside the housing save that which may be made when a car is being dumped. All dust created within the housing is pulled out by a Sturtevant 50-hp. fan, which discharges into a 4-ft. diameter flue or duct made of sheet iron, which in turn delivers in a straight line into a baghouse. The latter is a framework of 2 x 4's, on the inside of which are supported sheets of 7 oz. Osnaburg sheeting furnished by Bemis Bros. Bag Company, which forms the two side walls and top. Above the top canvas is a protective covering of galvanized iron. The baghouse, thus simply built, has a V-trough floor to permit sluicing out the settled dust. The structure is about 125 ft. long and 10 x 10 ft. in cross-section.

Water Sprays Used

Sprays have been provided on the inside to facilitate settling the dust. A 2-in. water line enters the structure at the fan end, and supplies water to two 1½-in. lines running down either side of the chamber on the floor. At the entrance and at 18-ft. intervals a ¾-in. line, set with P. E. Myers & Bro. Company spray nozzles 2 ft. apart, is tapped into one of these 1½-in. lines, passes up the side of the chamber, across under the top, and down the other side to the opposite 1½-in. line. A hose connection is provided also where the water line enters the chamber to permit sluicing out the dust at intervals. This has been necessary only once in three months, since the flow of water from the sprays removes most of the accumulated dust as it is collected.

The fan delivers 28,300 cu.ft. per minute when discharging into atmosphere at the end of 50 ft. of 49-in. smooth pipe. This volume has been cut to 22,600 cu.ft. per minute by the back pressure set up by the dust-filtering bag. The loss of 5,700 cu.ft. per minute constitutes opproximately 20 per cent of the original volume and may be reduced by extending the bag to furnish additional filtering area.

Photo-Electric Cell

Controls Peak Power Load at Mine

D. S. Burns

Industrial Division
Westinghouse Electric & Mfg. Co.
Indianapolis, Ind.

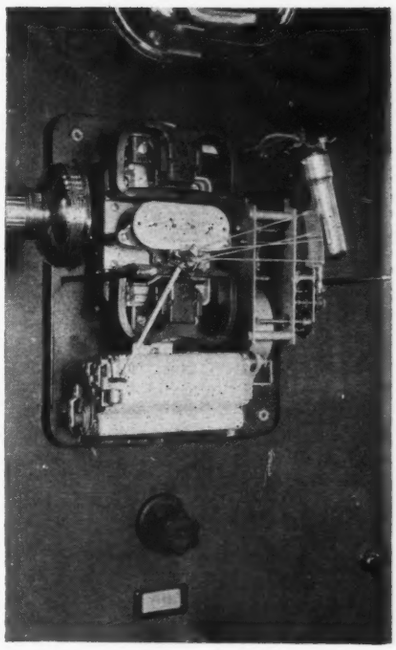
ONE OF THE MANY problems confronting mine operators today is the demand charge item of their monthly power bills. Many power companies have a demand clause in their rates, and in some instances this is measured over a definite time interval, usually 15 or 30 minutes. If during any interval a new demand is created, this serves as the billing demand for the following twelve months.

In the Dresser mine of the Walter Bledsoe Company, of Terre Haute, Ind., this was brought home to the owners through the oversight of a new employee. The new man started a 125-hp. motor while the main hoist was in operation, and a very high demand was the result. This experience started the company's electrical engineer, James Hyslop, to figuring some way to level off the demand and save on power bills. The device shown herewith has given reliable service for the past four years.

In this mine the hoist motor consumes about 40 per cent of the total energy, and it has been successfully demonstrated that by delaying the hoist operation from one to two minutes, the predetermined demand has not been exceeded. It is estimated that the first month, after the twelve months' period, the demand charge was cut $200.

To prevent an undesirably high peak demand being established during any predetermined interval, the pen arm of the demand meter must not move through too wide an arc during any recording time interval. To prevent this a photo-electric cell is used in conjunction with two movable shields so balanced that no additional load is put on the meter.

Coaxial with the shaft supporting the pen arm is a spindle carrying a set of arms to which the upper shield is attached. Journaled upon this spindle is a sleeve carrying radial extended arms to which the lower shield is attached, mating with the upper shield. The weight of the upper shield and its supporting arms is nearly counterbalanced by a suitable counterweight, just enough of the weight of the shield being unbalanced to insure normal resting of its lower edge against the top of the lower shield, which rests upon an adjustable pin. Attached to the pen arm is a threaded pin to which is clamped a finger arranged to have a one-way lifting engagement with one of the supporting arms of the upper shield. A light source consisting of a large flashlight redesigned to take an automobile headlight lamp is mounted to the left of the meter. The light is powered by a standard bell-ringing transformer energized from a standard 110-volt circuit.



AS THE PEN arm moves to the right, registering the peak load, a finger engages the support of the upper shield and it moves upward, permitting light from the flashlight to strike the photo-electric cell. This energizes a signal circuit and gives the warning by a bell or horn

On the other side of the shields a photo-electric cell is mounted in a metal holder having an aperture of a height equal to the movement of the shields. The signal circuit is of the closed-circuit type, one where no signal is given unless energy flow through the photo-electric cell is modified to a predetermined extent. This signal circuit is connected through an amplifying relay to two neon lamps located in front of the hoisting engineer. A predetermined kw. demand is chosen, and the attachment set by means of a cam arrangement so that when the demand is in danger of being exceeded the alarm is given.

If, in the fifteen minute demand period, there is no indication that the predetermined demand will be exceeded, the operation is as follows: The two shields will raise simultaneously at a rate equal to the desired average current consumption rate through the demand interval; and since the two shields have not separated, allowing light to reach the photo-electric cell, no signal is given, and the shields automatically drop to their original position.

If, however, at any time during a fifteen-minute interval current consumption is proceeding at too high a rate, the finger clamped to the pen arm will engage the support of the upper shield, raising it away from the lower shield, thereby allowing light to reach the photo-electric cell and energizing the signal circuit, lighting the lamps in front of the engineer. The engineer will then delay his hoisting until the lower shield, which is raising at a uniform rate, catches up with the upper shield, again shutting off the light and causing the signal lamps to go out. The shields drop to their original position at the end of the interval as before.

Any number of signal devices could be used in conjunction with the photo-electric cell. It might be connected to a signal bell or horn to give the warning, or connected in the control circuit of a large motor in such a way that the demand would be controlled automatically. In the application of this attachment to a conventional Type RA meter, the only change in the meter itself was in the cover. The standard cover was deepened about 4 in. and a glass window installed in the left side to permit the light from the light source to reach the shields.

A Qualitative Test For Molybdenum

Potassium ethyl xanthate gives reliable indication

R. H. Lowe
Metallurgical Engineer
Guy V. Martin Laboratories
915 East Central Ave., Albuquerque, N. M.

INCREASED DEMAND for molybdenum has aroused wide interest in prospecting, and a qualitative test that is positive and reasonably simple should aid in eliminating the expense of quantitative determinations on samples of little or no molybdenum content. The test here described is based on the fact that the reaction product of a xanthate and a molybdenum compound is highly colored, giving to solutions a color varying from pink to deep purple, and is comparable with the well-known dimethylglyoxime test for nickel in sensitivity and simplicity of manipulation.

Though knowledge of the reaction is not new, most of the previous published work has dealt with the separation of molybdenum from other elements, or with the development of a quantitative colorimetric method, and little or no emphasis has been placed on the sensitivity of the reaction as a positive qualitative test for molybdenum. For this reason the laboratory work was carried on with the object of developing a definite procedure for the positive qualitative determination of molybdenum in ores or other products.

Procedure is as follows:

(a) For ores or alloys use a one-gram sample, add 15cc. HNO_3, 10cc. HCl, and 5cc. H_2SO_4, and boil to dense SO_3 fumes.

(b) For solutions add 5cc. H_2SO_4 to 25cc. and boil as in (a).

(c) Cool (a or b), add about 20cc. water, and boil until soluble salts are in solution. Add strong NaOH solution until slightly alkaline, boil for a few minutes, and settle. The volume should not be over 100cc. at this point.

(d) Decant 10 to 20cc. through a No. 3 Munktell filter paper into a 6-in. test tube, add about 0.1 gram solid potassium ethyl xanthate, then one or two drops concentrated H_2SO_4. The presence of molybdenum is indicated by a light pink to deep purple color, depending on the amount present.

(b) With solutions containing only traces of molybdenum it is advisable to use a larger sample and boil to desired volume.

(c) Boiling after precipitation with NaOH promotes settling and also renders cobalt insoluble.

(d) The solution may appear clear, but should be filtered, inasmuch as small amounts of copper and iron precipitates, not discernible to the eye, are sensitive to the xanthate. If present, they produce a brown or yellow precipitate with xanthate preceding the addition of the H_2SO_4. Any alkaline xanthate may be used for the test, but the potassium ethyl is preferable.

As to the sensitivity of the test, molybdenum can be detected, with practice, in solutions if it is present in the ratio of 1 part in 4,000,000. One part in 2,000,000 is easily detected. Converting parts per million to percentages we find this equivalent to 0.0025 per cent and 0.005 per cent respectively, when using a one-gram sample and making up to 100cc. of solution.

Though molybdenum is the only element found in this laboratory that gives a pink to purple color, several other elements, if present, give colored compounds that will mask the test. The most important, because of their frequent association with molybdenum, are copper and iron. Vanadium also gives a colored compound but does not interfere with the test except where the ratio of vanadium to molybdenum is extremely high. In such a case the two elements can be separated by precipitating the molybdenum with H_2S in an acid solution and treating the precipitate in the usual manner.

Other metals giving colored compounds with xanthate but not usually associated with molybdenum ores are nickel, cobalt, and chromium. All the metals mentioned in the foregoing except vanadium are removed in the course of procedure. The separation of iron and molybdenum as given here is not absolutely quantitative, minute amounts of molybdenum being held up by the iron hydroxide, but this has no appreciable affect on the test, in that the amount held up is so small a percentage of the total amount present.

The test has been used several years in this laboratory and has invariably proved to be entirely reliable.

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Longer Life for Mine Maps

Rollin Farmin
Chief Engineer and Geologist
Idaho-Maryland Mines Corporation
Grass Valley, Calif.

AT EVERY MINE a few general maps bear the brunt of the wear and abuse of daily handling. The life of such a map is sometimes not more than a year, especially if it is rolled for storage while it is not in use. Its ink lines become broken and dimmed as the ink film cracks and scales off and as colored ink fades from exposure to sunlight. Creasing and snagging of a tracing cloth map sheet break the glazed starch surface and fracture the ink film; grime works into the fabric and destroys its transparency; and in a little while a new map must be prepared to replace the old one.

The most important step toward prolonging the life of a map is to store and use it flat—never rolled. The system now used by the Idaho-Maryland Mines Corporation has a few new features. The mining area is divided into blocks similar to the sections in a township. For each block a series of map sheets are made up of uniform size: they show the workings and geology of each mine level, with a special sheet to show all levels in composite plan and another showing topography and areal geology. These map sheets are mounted in order on

a baseboard of reinforced, three-ply veneer and are anchored upon it by "Cello-Clips" which snap around three short posts spaced along the top margin of the board. The "Cello-Clips" permit an individual sheet to be removed from or replaced to its position deep in the block without first removing the overlying maps. The block of maps is stored or laid out for inspection as a unit, either in horizontal or vertical position. Spring catches, resembling mousetraps, hold the two lower corners of the sheets tight against the baseboard to prevent fluttering and curling of the sheets while the block is being carried from table to map vault.

The second step in prolonging the life of the map is to apply a coat of fixative to cover and protect all new ink lines or crayon colors as soon as they have thoroughly dried after their addition to the map. The fixative used is Fuller's NL 4434, a clear gloss lacquer which is thinned with lacquer-thinner for quicker drying to prevent the softening of certain colored inks. It is brushed or sprayed lightly over the strip of newly added workings and geologic symbols, dries quickly, and provides a transparent, water- and wear-proof coating.

In anticipation of need for erasing portions of the line work on composite maps, where overlap of levels may develop, the following technique is useful: A foundation coat of lacquer is brushed on the sheet and is allowed to harden for a day before the new ink lines are posted on it. The inking is made easier if the slick lacquered surface is first rubbed with "pounce" or talcum powder. After inking, a fixative coat of lacquer is added in the usual way, but more lightly, to prevent softening of the foundation coat. At some later date, when an erasure is to be made, the ink lines are simply wiped off with a twist of "Kleenex" moistened with lacquer-thinner, which removes the two lacquer layers and the ink lines sandwiched between them. An erasure made in this way does not damage the map sheet fabric nor does it leave telltale spots on prints made from the map.

Valuable old maps from which much ink has been lost are brightened markedly by a coat of clear gloss lacquer by the same optical principle which makes mineral textures in rock specimens more clearly visible if they are wet with water or have been lacquered.

Reclaiming and preserving of old maps sometimes includes patching cuts and holes: a patch of extra-thin tracing cloth can be cemented to the back of the damaged area with collodion. The same cement can be used to graft an extra strip of tracing cloth to the end of a short map.

Mechanical Loader Cuts Cost at Utah Mine

L. A. Walker

Superintendent United States Mine

United States Smelting, Refining & Mining Company, Bingham Canyon, Utah

ONE EFFECT of rising labor costs is the growing use of mechanical devices that will not only do the work formerly done by hand, but at a lower unit cost. A case in point in metal mining is the increasing use of mobile underground loading machines and scraper loaders. (E. & M.J., May, 1937, p. 241). The development is logical, for economy in mining should begin at the mine itself. Waste or loss in the production of ore cannot be recouped in subsequent milling or smelting operations. And under current economic conditions, one of the most effective ways of maintaining a mining company's profit position is to reduce cost and increase efficiency all along the line.

Since 1933, the Eimco-Finlay underground loader has been used in the United States mine of the U. S. Smelting, Refining, and Mining Company, Bingham Canyon, Utah. In spite of the natural deficiencies of the pioneer machine, which have since been remedied, it showed an immediate saving of 20 per cent compared with hand mucking. Subsequent improvements have resulted in greater efficiency and utility.

The accompanying table gives detailed costs at the United States Mine, showing the comparative performance of Eimco-Finlay machine loading and hand loading. Data represent an average day's run on a lower level where two drift headings could be handled by one macheine. Both rounds were drilled and blasted on night shift and mucked on the following shift. Time distribution on the loading shift was: 120 minutes actual operation of the machine, loading 26 cars of 36 cu.ft. capacity at the rate of 4.6 minutes per car; 80 minutes hand tramming 26 cars; 25 minutes moving loading machine to second heading. The remainder of the shift was used in hand-cleaning sides, waiting for cars, timbering, and miscellaneous work.

Cost per Ton by Mechanical Loading

Average tons per shift	52
Life of machine estimated at 10 years	
Original cost of machine	$1,850.00
Plus 3% interest compounded annually for ten years equals	2,468.25
Initial cost per year	248.625
Average cost of parts and repairs per year	402.570
Total cost per year	$651.195
Average working shifts per year	246
Cost of machine per shift, $651.195 ÷ 246	2.647
Cost of machine per ton, $2.647 ÷ 52	0.0509
Cost of operator per shift	$5.25
Cost of helper per shift	4.65
Total labor cost per shift	$9.90
Labor cost per ton, $9.90 ÷ 52	0.1904
Cost of compressed air per cubic foot at 85 lb. per square inch pressure averaged	0.000117

The average air consumption measured with a New Jersey meter was 168 cu. ft. per minute. The machine was operating approximately one quarter the time per shift and therefore used 168 x 120, or 20,160 cu. ft.

Cost of air used by machine per shift, 20.160 x $0.000117	$2.3537
Cost of air used by machine per ton, $2.3587 ÷ 52	0.0458

Summation

Cost of machine per ton	0.0509
Cost of labor per ton	0.1904
Cost of air per ton	0.0453
Total cost per ton mechanically loaded	0.2866

Cost per Ton by Hand Mucking

Average tons per shift per man, 13	
Wage per shift	$4.65
Cost of labor per ton, $4.65 ÷ 13	0.57
Average life of shovel	105 shifts
Cost of shovel per shift, $1.365 ÷ 105	0.013
Cost of shovel per ton, $0.013 ÷ 13	0.001

Summation

Cost of labor per ton	$0.357
Cost of shovel per ton	0.001
Total cost per ton hand loaded	$0.358

Cost Comparison

Cost per ton hand loaded	$0.358
Cost per ton mechanically loaded	0.287
Difference	$0.071
Saving, 19.8 per cent	

PERSONAL ITEMS

J. H. Marsman recently arrived in Europe from the Philippines.

Col. H. W. Laws, consulting engineer of Victoria, B. C., sailed on Oct. 30 for Burmah.

H. M. Hartmann is now manager of the Mountain City Copper Company, at Rio Tinto, Nev.

Earle W. Bedford, mining engineer, left Manila on Oct. 25 to examine two gold properties in Jahore.

Frank T. M. White has left Mount Magnet, Western Australia, to accept the appointment of mining engineer to the Department of Mines in the Colony of Fiji.

Dr. Hans Pirow has been appointed a director of East Geduld Mines and Geduld Proprietary Mines, both South African Rand operations.

Prof. Douglas Johnson, geologist, has been appointed executive officer of the department of geology and mineralogy at Columbia University, New York.

R. J. Lemmon, field metallurgist, Imperial Chemical Industries, Ltd., has returned to London after a visit to Southern Europe.

Grover J. Holt, of St. Paul, mining engineer of Butler Bros., completed an inspection trip to the Mesabi range the first part of the month.

F. M. Passon has assumed the management of the Edwards Gold Mines, Ltd., at Lochalsh, in the Algoma district of Ontario.

B. F. Edwards, president of the Tonopah Divide Mining Company, has been at the Nevada property from his San Francisco headquarters.

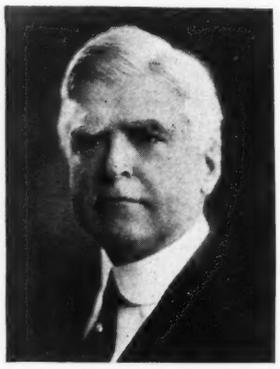
Prof. E. S. Moore has been appointed to head the department of geology at the University of Toronto. He has been a member of the faculty of the university for fifteen years.

John N. Becker, superintendent of the Zeibright unit of Empire Star Mines Company, Ltd., has returned to Nevada City, Calif., from a professional trip to South Africa.

Walter I. Nelson, mining engineer, until recently with California Engels Mining Company, has joined the staff of Mother Lode Central Mines, Inc., Angels Camp, Calif.

Charles W. Henderson, supervising engineer, United States Bureau of Mines, Denver office, and **H. H. Hughes,** editor of the "Minerals Yearbook," recently visited the San Francisco office of the Bureau on professional business.

Dr. George S. Rice, chief mining engineer of the United States Bureau of Mines, has retired from the Bureau. He reached the legal age limit a year ago, but his service was extended one year by Executive order. Dr. Rice is an outstanding authority on coal-mine explosions. He was born at Claremont, N. H., Sept. 8, 1866. After two years' study at the College of the City of New York, he entered the School of Mines of Columbia University, finishing with the degree of engineer of mines in 1887. In 1908 Dr. Joseph A. Holmes, chief of the technological



DR. GEORGE S. RICE

branch of the Bureau of Mines, and later first director, offered Rice the post of chief mining engineer in charge of mine-accident prevention investigations. He was sent to Europe to study the most advanced practice in Great Britain, France, Belgium, and Germany. On his return to the United States, Dr. Rice and members of his staff began an extensive study of coal-mine explosions. He rendered effective service during the World War in supporting the manufacture of devices for protection against gas. Later, Dr. Rice gave especial attention to the mining of potash salts, mining oil sands in Europe, use of liquid oxygen explosives, surface submergence in mining, and gases in coal mines. In 1924 he was appointed chairman of the newly organized Mine Safety Board of the Bureau. His retirement marks the completion of 50 years of professional work and 30 years in Government service. Honorary membership has been conferred on him by the British Institution of Mining Engineers, the A.I.M.E., the Mining Society of Nova Scotia, and the Société de L'Industrie Minerale, of France. Dr. Rice is author of numerous official scientific bulletins and many contributions to the technical press. He will continue to reside at his home on the Virginia bank of the Potomac River near Mount Vernon.

Clyde Garrett left Reno recently to examine new discoveries in the Black Hills district in South Dakota.

Edmund C. Bitzer, superintendent of the Cal Horr mill of the Benguet Consolidated Mining Company, Philippine Islands, recently completed an extended vacation in the United States.

Frank Mulford, mining consultant to Time, Inc., recently returned to New York following a six-weeks' trip visiting western mining districts.

T. R. Victor, mining engineer and director of Golden Plateau, Cracow, Queensland, has returned to Melbourne after a periodical visit of inspection to the mine.

A. P. Cortelyou, directing a tungsten operation near Bishop, Calif., for the United States Vanadium Corporation, has been examining scheelite prospects near Goldfield, Nev.

Charles V. Harris, metallurgical engineer, formerly mill superintendent for Cia. Minera Las Animas, S. A., Caborca, Sonora, Mexico, is now in Berkeley, Calif.

W. Prince Catlin, for many years acting as field geologist for the Southern Pacific Railroad Company, has been investigating newly opened mining districts in Nevada.

William O. Vanderburg, field engineer for the United States Bureau of Mines, lately inspected new silver-lead discoveries in the Merrimac or Lone Mountain district, 30 miles northwest of Elko, Nev.

T. L. Oddie, former Governor and United States Senator from Nevada, now president of the Gold Mining Association of America, has been active lately in developing mine properties in northern Churchill County, Nev.

William Porri has been made superintendent of the Leatherwood copper mine, in the Old Hat district near Oracle, Ariz., which is operated by the Catalina Consolidated Copper Company.

Dr. H. Foster Bain, who has recently been in China and Japan, has returned to Manila, where he can be reached at the Manila Hotel. Dr. Bain will spend much of the coming year in the Far East acting as advisor on mining to the Commonwealth of the Philippines.

B. Berthelson, mining engineer, is now a member of the staff of the Zeibright mine, Empire Star Mines Company, Ltd., Emigrant Gap, Calif. He was formerly advisory engineer for La Luz Development Corporation, with headquarters at Guanajuato, Mexico.

Merle H. Guise, gold placer specialist, is completing his examination and development of dragline and dredging ground in Fairbanks district, Alaska, and is returning to California, where he may be reached care St. Francis Hotel, San Francisco.

John C. Russell recently left the Empire Star Mines Company, Ltd., at Grass Valley, Calif., where he was employed as cyanide operator, and is now in charge of the milling operations of the Belden Amador Mine, Inc., at Pine Grove, Calif.

R. C. McCarthy, manager for the Copper Canyon Mining Company near Battle Mountain, Nev., has returned to his office there from New York, where he was called to confer with company officers on expansion plans that involve mill construction and sinking a deep central shaft.

J. B. Stapler, consulting engineer for Marsman & Company, Manila, P. I., and manager of that company's Southern Division, arrived, with Mrs. Stapler, in New York from London, on the "Queen Mary," on Oct. 4 on vacation. He expects to return to the Philippines on Jan. 6 next.

Cecil Brehaut was recently made resident mine engineer at the Copper Mountain property, near Allenby, Princeton, B. C., and not mine manager, as reported in the September issue. His courtesy in sending the correction to the item is appreciated.

Otto D. Rohlfs has joined the Marsman interests, and is now on the staff of Marsman Hongkong China, Ltd. He received his degree of engineer of mines from Columbia University in 1905, and has since had wide experience in the United States, Alaska, and Mexico.

Dr. Paul Dyer Merica, director of research of the International Nickel Company and vice-president of the International Nickel Company of Canada, has been awarded the 1938 John Fritz Gold Medal, highest of American engineering honors, for "important contributions to the development of alloys for industrial uses." The award is made annually for notable scientific or industrial achievement by a board composed of representatives of the four

DR. PAUL DYER MERICA

national engineering societies of civil, mining and metallurgical, mechanical, and electrical engineers. Dr. Merica was born in Warsaw, Ind., on March 17, 1889. He studied from 1904 to 1907 at De Pauw University, which in 1934 conferred upon him the degree of doctor of science. In 1909 he received the bachelor of arts degree from the University of Wisconsin, and in 1914 the Ph.D. degree from the University of Berlin. Following five years of work as research physicist in the United States Bureau of Standards, Dr. Merica in 1919 became director of research of the International Nickel Company.

Frank Bergstrom, formerly general superintendent of iron ore division of the Wheeling Steel Corporation, recently resigned and **Charles R. Emerson,** mine superintendent, was appointed to succeed him. **Edwin C. Johnson,** office manager, has been appointed assistant general superintendent. The offices of the corporation are in Virginia, Minn.

Lawrence E. Smith recently arrived in Manila to join the staff of Sur Oriental. A graduate of the Colorado School of Mines, class of 1931, he has been working on various properties in Colorado since his graduation.

J. H. Sampson, consulting engineer for the Soriano interests in the Philippines, is now in Canada on a vacation trip which has taken him around the world via the important mining areas. He is expected back in the Philippines by the end of the year.

F. P. Simmons, mining mechanical engineer of San Francisco, reached Manila a short time ago to join a Philippine company. He was formerly on the staff of the Sierra Consolidated Mining Company in Reno, Nev.

Paul Sirkegian, resident engineer for the Consolidated Copper Mines Corporation at Kimberly, Nev., has been examining cinnabar properties in northern Humboldt County, under option to associates.

David Hutchinson has left the Eldorado Gold Mines, in Great Bear Lake, Canada, to join the West African Gold Corporation. He is acting in the capacity of shift boss at the Akosso mine, in the Gold Coast Colony, British West Africa.

W. E. Wainwright, who recently retired from the position of general manager of Broken Hill South, Ltd., was awarded the medal of the Australasian Institute of Mining and Metallurgy at the annual meeting held recently at Port Pirie, S. A., in recognition of his contributions toward the development of the mining industry in Australia.

D. A. Macleod, formerly dust control engineer at the Hollinger mine, Timmins, Ontario, has been appointed by the Workmen's Compensation Board of British Columbia to act as an advisor in the improvement of dust conditions in mines throughout the Province. He will act in co-operation with the Mining Association of British Columbia.

Charles H. Segerstrom, president of the Nevada-Massachusetts Company, Inc., largest American producer of tungsten, lately visited the company's mines and concentrators near Mill City, Pershing County, and near Mina, in Mineral County, Nev., from his Sonora, Calif., office.

J. D. Hitch, who has been resident engineer in Tokyo, Japan, during the past eight years for The Dorr Company, has returned to New York to take over the duties of manager of the company's export division. He will have general charge of Dorr activities in Japan, Australia, and South America. **T. B. Ford,** who was assisting Mr. Hitch in Tokyo, has taken his place. **Charles W. Burgess,** resident Dorr engineer in the Philippine Islands since 1932, has returned to New York for a visit of several months, after which he will resume his duties in Manila. To carry on during Mr. Burgess' absence, **William W. Cowan,** of the Dorr development staff, recently flew to Manila via "Clipper" plane.

H. F. McFARLAND

H. F. McFarland, mining engineer, formerly employed by Cerro de Pasco Copper Corporation at Morococha, Peru, South America, sailed on Oct. 26 for Capetown, where he has accepted a position with the West Rand Consolidated Mines, Ltd.

S. E. Stein writes from Manila that his company (Southwestern Engineering Company of P. I., Inc.) has completed construction of its first mill, a 150-ton plant for treating lead-zinc-gold ore, in less than 3½ months, in the face of general opinion that a mill could not be built in the Philippines in less than seven months. The 1937 low-cable rates from the Islands to the United States, and "Clipper" air-mail facilities, were most helpful. The mill is on Marinduque Island.

OBITUARY

An appreciation of William Kelly, whose death was chronicled in the October issue, will be presented in the December number.

Percy C. Brooks, former executive vice-president of Fairbanks, Morse & Company, died at his home in Chicago on Oct. 15. He was 65 years old.

E. P. Hawkins, 29, mine shift boss at the Balatoc Mining Company, was killed Sept. 17 while inspecting the mine shaft in the drain tunnel. A native of Reno, Nev., he was a graduate of the Nevada School of Mines, and went to the Philippines about a year ago.

Charles V. Drew, mining engineer, vice-president and director of Cerro de Pasco Copper Corporation, died in Boston of Sept. 26 at the age of 64. Mr. Drew was an alumnus of the University of Chicago (B.S.) and of Michigan College of Mines, from which he received his degree as a mining engineer. He had been with Cerro de Pasco since 1904. He was also vice-president and director of the Cerro de Pasco Railway and a director in the United States Metal Company.

A. R. Davis, Jr., assistant mine superintendent at the Itogon Mining Company, died on Aug. 13. Mr. Davis was a native of Longview, Wash., and was a graduate of the Oregon State College School of Mines. In 1933 he went to the Philippines to join the staff of Suyoc Consolidated and was transferred to Itogon in 1935.

A. J. T. Nettell, secretary of the Vancouver office of the Geological Survey of Canada, died on Oct. 3 at the age of 65. Everyone connected with the mining industry, of every class, from operator to prospector, who came in contact with him during his nineteen years of service in this capacity, had a high and warm regard for him. A metallurgist by profession, he came to British Columbia in 1918 after having gained experience in Swansea, where he was born, and in Ireland and Mexico.

Albert J. Bone, mining engineer and metallurgist, died in Toronto on Oct. 8 at the age of 56. Mr. Bone was a graduate of the Missouri School of Mines. He was a specialist in copper mining and smelting and had served on the staffs of the Tennessee Copper Company, Granby Consolidated, British America Nickel, the General Development Company, and Basin Mining Company, Ltd.

J. Sterling Place, vice-president of the Hudson Smelting & Refining Company, of Newark, N. J., and the Industrial Metal Company, Inc., died on Oct. 9 as the result of an automobile accident. Mr. Place was a mining engineer, having been graduated from the Colorado School of Mining. He had spent much of his business life in the South American countries.

Frederick Kruse, a mining engineer of 39 Broadway, New York, died on Oct. 28 at Leroy Sanatorium in that city. He was 57 years of age. Mr. Kruse was born at Black Hawk, Colo., where his father was a pioneer. He spent his early life in a mining environment and later went to Columbia University, where he was graduated with the degree of mining engineer. Since graduation he had been employed continuously in the offices of the late George J. Gould. He is survived by his wife and three children. Interment was in Denver, Colo.

Downie D. Muir, Jr., vice-president and general manager of the United States Smelting, Refining & Mining Company, died at his home in Boston, Mass., on Oct. 23. He was born in Lincoln, Neb., in 1884, and was graduated as a mining engineer from Columbia University in 1906. He joined the company in 1910, spent some time in Alaska, and was then transferred to Salt Lake City, where he made headquarters for fifteen years. He attained his late post in 1934.

Albert H. Fay, mining engineer, long prominently identified with enterprises in fields of wide divergence, editor and writer, died on Aug. 7 last in his 67th year. He was an alumnus of the Missouri School of Mines and in addition to his professional activities as an engineer and his services in the United States Bureau of Mines, he had on two occasions been an assistant editor on the staff of *Engineering and Mining Journal*—first in 1909, 1910, and 1911 and later as news editor under the editorial régime of Josiah Edward Spurr. Mr. Fay's most noteworthy contribution to the literature of mining was his "Glossary of the Mining and Mineral Industry," which remains a standard — but rare — book of reference. A sketch of his career was presented in *E.&M.J.* of Oct. 22, 1921.

ALBERT H. FAY

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Letters

East Mindanao Costs

The Editor:

I WISH to call to your attention an error in the August number of *E. & M. J.* with regard to East Mindanao costs and production. In Table II, on page 389, cost is given as 20.32 pesos and 1936 revenue as 16.87 pesos per ton. I cannot imagine where these figures came from, as they are entirely incorrect. Please refer to my article on this mine in the May issue. Costs for the end of 1936 were about 9.57 pesos for operating and all current charges; if the charge for capital items such as property and original development, as well as amortization of the mill investment, be added, the total as I recall, came to about 13.55 pesos, as this fixed capital charge was being made at the rate of 4 pesos per ton at the time I left. It should be noted that the mill started late in August, and for the first five or six weeks we broke it in on low-grade dump ore, which naturally pulled down the average for the remainder of the year. Since I happen to know that many of the costs appearing in Table II for other mines are operating figures only, and some of them incomplete at that, I naturally would like to see the figures for our own venture rendered correctly.

J. B. KNAEBEL

The correspondent of *Engineering and Mining Journal* in Manila states that the data in Table II, to which Mr. Knaebel refers, were obtained from the annual reports of the various companies. East Mindanao's fiscal year, however, ends on Oct. 31. The figures given in that company's balance sheet, from which the table was compiled, therefore represent only two months of operation. This should have been explained but was overlooked.

The figures 20.32 pesos and 16.87 pesos for cost and revenue for the months of September and October, 1936, are according to the company's annual report. The balance sheet shows that the company had a loss on operation for this period of 18,475.17 pesos.

Our correspondent further states that it is true that many of the costs appearing in Table II for other mines are operating figures only, the reason being that the only way in which costs can be computed in most cases in the Philippines is by analyzing the annual reports and balance sheets published by each company.

THE EDITOR

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Development of the Microsplitter

The Editor:

I HAVE JUST READ "Splitting Small Samples Accurately With the Microsplitter," published in your April, 1937, number. I wish to call your attention to the "Microsplit" designed and built by Mr. George H. Otto, now of the Soil Conservation Service at Pasadena. Mr. Otto developed the splitter while at the University of Chicago, and later, at California Institute of Technology, perfected the device and carried out a number of tests on its efficiency. He described this sample splitter at the meetings of the Cordilleran Section of the Geological Society of America in April, 1932. An abstract of this paper ("Device for Sampling Heavy Minerals") is given in the Bulletin of the Geological Society, Vol. 44, p. 159. In April, 1933, Mr. Otto published his work as a paper, "Comparative Tests of Several Methods of Sampling Heavy Mineral Concentrates," in the "Journal of Sedimentary Petrology," Vol. 3, pp. 30-39. In this paper a photograph of the sampler is included and the results of tests on the device are included.

The record shows quite clearly that Mr. Otto should have credit for the invention and demonstration of the efficiency of the miniature Jones riffle type of splitter. May I also call your attention to another sampler of different design, namely that of Wentworth, Wilgus, and Koch, published in the "Journal of Sedimentary Petrology," Vol. 4, 1934, pp. 127-138, under the title of "A Rotary Type of Sample Splitter."

F. J. PETTIJOHN,
Sedimentology Laboratories,
Department of Geology,
University of Chicago.

NEW BOOKS

INTERNATIONAL CONTROL IN THE NON-FERROUS METALS. *By W. Y. Elliott, E. S. May, J. W. F. Rowe, Alex Skelton, and Donald Wallace. The Macmillan Company, New York. Pp. 801. Price $6.50.*

THIS VOLUME presents the results of an extended study of political and economic effects resulting from existing effort by producers or governments to control production of non-ferrous metals.

Nearly 90 per cent of the volume, called Part II, is made up of monographic chapters by the several authors, presenting historically the factual problems of nickel, aluminum, tin, copper, lead, and zinc. The presentation is that of an economist, but with real appreciation of the mineral resource aspects. In each case the major objective of the summaries is a statement of production control, cartels, and other economic measures, with an explanation of purposes sought and the major international effects resulting.

The volume affords a work of outstanding value to any executive or engineer concerned with the production of these six metals or their marketing. The careful economic research of the authors insures a high degree of dependability for the volume. For many years it will remain an important reference work, explaining the economic situation of these non-ferrous metals at the end of the great depression.

To a limited extent, technologic and engineering factors which affect production and marketing have been discussed. These considerations are, however, decidedly secondary to the economic and political considerations which are dominant in the minds and purpose of the authors. The engineering reader will, therefore, find little of technical value, but much of outstanding economic usefulness for the planning of technologic methods and advances.

R. S. MCBRIDE

THE STORY OF TUNNELS. *By Archibald Black. Published by Whittlesey House, McGraw-Hill Book Company, 330 West 42d St., New York City. Pp. 245, with 46 photographic reproductions. Price $2.75.*

FOR UNNUMBERED CENTURIES man, from the first primitive human animal up to his in-some-part civilized descendants of today, has found a fascination—and a measure of safety—in burrowing in the earth; in making caves and tunnels. Similar phenomena may be observed among the fauna of all lands and in the habits of birds and insects.

Mr. Black, who is a special writer for the Port of New York Authority, has, with his publisher, made available an exceptionally interesting historical record of tunneling, written in such form as to be easy and pleasant reading for the non-technical man and woman. The work is valuable, moreover, alike to the engineer, and to others concerned with the building of tunnels and to that large group of folk who maintain private libraries as a source of personal and family culture and information.

In this single volume the layman will find about all he wants to know about tunnels, their form of structure, and their uses. It is a splendid reference work of the subject treated, and is effectively indexed. The book is a companion volume to the "History of Bridges," also written by Mr. Black and put forth by Whittlesey House.

PUBLICATIONS

RECEIVED

✦*Tests of Strength Properties of Chilled Car Wheels.* By F. E. Richart, R. L. Brown, and P. G. Jones. Bulletin 294, Engineering Experiment Station, Urbana, Ill. Pp. 70. Price 85c.

✦*Mineral Thermometer.* By O. W. Grawe. This is a compilation of melting points and transition points of minerals. Technical Series Bulletin, School of Mines and Metallurgy, Rolla, Mo. Pp. 8 and a chart.

✦*Pyrochemical Changes in Missouri Halloysite.* By F. J. Zvanut, L. J. Wood, C. M. Dodd, and W. T. Schrenk. School of Mines and Metallurgy, Rolla, Mo. Pp. 42.

✦*Map of Canadian Mines.* C. Tarling & Co., Toronto, Canada. Four colors, 54x36 in., mounted on linen, wall style with top and bottom rollers, or folded. With index. Price $10. Spring roller $12.50.

✦*Les Resources minerales de la France d'outre-Mer.-V.* Le Petrole. Published by Société d'Editions Geographiques, Maritimes et Coloniales, 17 rue Jacob, Paris, VIe.

The following bulletins (in Portuguese) have been received from the National Department of Mineral Production, Rio de Janeiro, Brazil:

✦*Geologia de Municipio de Curityba.* By Paulino Franco de Carvalho. Bulletin 80. Pp. 37, with map.

✦*Notas Geologicas Sobre o Municipio de Taquara, Rio Grande do Sul.* By J. Miranda. Bulletin 83. Pp. 38, with map.

✦*Travalhos Geophysicos Applicações dos Methodos Electricos.* By M. C. Malamphy, H. C. A. de Souza, I. C. do Amaral, and D. S. Oddone. Bulletin 81. Pp. 50.

✦*Reconhecimento Geologico na Serie Assunguy.* By Paulino Franco de Carvalho and Estevam Alves Pinto. Bulletin 71. Pp. 29, with map.

✦*Recursos Mineraes do Estado do Rio Grande do Sul.* By Paulino Franco de Carvalho. Bulletin 72. Pp. 38, with map.

✦*Relatorio Final da Com. Nac. de Siderurgia.* Bulletin 75. Pp. 171.

✦*Rio Gurupy.* By Pedro de Moura. Bulletin 78. Pp. 66, with map.

✦*A Politica do Ouro.* By Euzebio Paulo de Oliveira. Dated October, 1934. Pp. 46.

The following papers have been issued by the U. S. Bureau of Mines, Washington, D. C.:

✦*Aerial Tramways in the Metal Mining Industry.* Part I. By O. H. Metzger. I. C. 6948. Pp. 32.

✦*Progress Report No. 4 on Investigations of Detachable Rock Drill Bits.* By McHenry Mosier. I. C. 695. (Printed by Timken Roller Bearing Company, Canton, Ohio, under a cooperative agreement with the U. S. Bureau of Mines.)

✦*Report of State Geologist on the Mineral Industries and Geology of Vermont, 1935-36.* By Elbridge C. Jacobs. Pp. 155.

✦*Summary Review of the Gold Mining Industry in Canada, 1936.* Dominion Bureau of Statistics, Ottawa. Pp. 86. Price 25c.

✦*Forty-fifth Annual Report of Ontario Department of Mines,* including statistical review for 1935, list of mines, quarries, and works in 1935, with description of mines and their operations in 1935. Toronto. Pp. 235.

The following publications have been issued by the U. S. Geological Survey and are for sale by the Superintendent of Documents, Washington, D. C.

✦*Geophysical Abstracts 87, July-December, 1936.* Compiled by W. Ayvazoglou. Bulletin 87. Pp. 98. Price 15c.

✦*The Yukon-Tanana Region, Alaska.* By J. B. Mertie, Jr. Bulletin 872. Pp. 276 and map. Price 70c. (paper cover).

✦*Geology and Ground-Water Resources of Ogden Valley, Utah.* By R. M. Leggette and G. H. Taylor. Water-Supply Paper 796-D. Pp. 161 and map. Price 10c.

✦*Thermal Springs in the United States.* By N. D. Stearns, H. T. Stearns, and G. A. Waring. Water-Supply Paper 679-B. Pp. 61 to 206 inclusive, with map. Price 35c.

The following bulletins have been issued by the Geological Survey of Newfoundland, at St. Johns:

✦*Geology and Mineral Deposits of the Pilleys Island Area.* By G. H. Espenshade. Bulletin No. 6. Pp. 56 and map.

✦*Geology and Mineral Deposits of the Hare Bay Area.* By John R. Cooper. Bulletin No. 9. Pp. 36 and map.

✦*Geology and Mineral Deposits of Hawke Bay-Great Harbour Deep Area, Northern Newfoundland.* By F. C. Foley. Bulletin No. 10. Pp. 22 and map.

✦*Marble Deposits of Northern Newfoundland.* By George W. Bain. Bulletin No. 11. Pp. 43.

MONTHLY COMMENT • DAILY AND AVERAGE MONTHLY

Summary of the

MARKETS

THE rate of business activity continued to move downward during October, and confidence everywhere was badly shaken because of the sharp decline in the securities markets. Consumers, disturbed over the uncertainty in the business outlook, bought comparatively little metal. Producers moved to restrict production, but this failed to influence trade. As October ended, the steel companies in this country were operating at 48.6 per cent of capacity, against 66.1 per cent a month previous and 74.7 per cent a year ago. The *E.& M.J.* index of prices declined from 94.33 in September to 85.26 in October. Domestic copper declined three-quarters of a cent; lead one-half cent; zinc three-quarters; and tin 8¼c.

Sales of copper in the domestic market during October came to only 23,238 tons, against 28,936 tons in September. Business booked outside of this country, however, was in good volume, despite the downward trend in prices. The foreign group reported sales of 97,000 tons, which compares with 72,000 tons in the preceding month. As the month of October ended a leading custom smelter offered copper at 11⅜c., but the large mine operators held nominally to 12c. World stocks of copper on Oct. 1 amounted to 344,738 tons, which compares with 331,311 tons a month previous.

Lead was lowered to 5.50c., New York, but the decline failed to stimulate business sufficiently to stabilize the market. Stocks of refined lead dropped to 90,742 tons during September.

Imports of zinc into the United States during September are officially reported at 14,741 tons, against 3,960 tons in August and 1,358 tons in September last year. Lower London prices forced the quotation in St. Louis down to 5.75c.

The Tin Committee announced that production for the first quarter of 1938 would be reduced 25 per cent, unless conditions improve. Quicksilver and platinum were lower. Tungsten ore was quiet and the situation eased somewhat compared with a month previous. Antimony showed little net change in price.

UNITED STATES MARKET

1937	Electrolytic Copper Domestic	Electrolytic Copper Export	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
Oct.						
1	12.275	11.850	56.250	6.00	5.85	6.50
2	12.275	11.950	57.250	6.00	5.85	6 50
4	12.525	12.125	57.625	6.00	5.85	6.50
5	12.275	12.100	55.625	6.00	5.85	6.50
6	11.775	11.600	54.625	6.00	5.85	6.25
7	11.775	11.625	54.750	6.00	5.85	6.25
8	11.775	11.650	55.000	6.00	5.85	6.25
9	11.775	11.600	54.375	6.00	5.85	6.25
11	11.775	11.650	54.000	6.00	5.85	6.25
12	11.775	11.600	52.625	Holiday	Holiday	Holiday
13	11.775	11.500	51.625	6.00	5.85	6.25
14	11.775	11.300	51.875	6.00	5.85	6.00 @ 6.25
15	11.775	11.225	50.500	5.75	5.60	6.00
16	11.775	11.200	50.250	5.75	5.60	6.00
18	11.775	11.200	50.625	5.50	5.35	6.00
19	11.775	10.500	48.250	5.50	5.35	6.00
20	11.775	10.550	48.375	5.50	5.35	6.00
21	11.775	10.825	50.375	5.50	5.35	6.00
22	11.775	10.900	49.750	5.50	5.35	6.00
23	11.775	10.900	49.375	5.50	5.35	6.00
25	11.775	10.525	48.250	5.50	5.35	5 75
26	11.775	10.625	48.625	5.50	5.35	5.75
27	11.775	10.450	47.750	5.50	5.35	5.75
28	11.525 @ 11.775	10.600	48.750	5.50	5.35	5.75
29	11.525	10.650	48.500	5.50	5.35	5.75
30	11.525	10.675	48.000	5.50	5.35	5.75
For month average	11.838	11.207	51.654	5.740	5.590	6.085
Oct.			AVERAGES FOR WEEK			
6	12.192	11.888	56.188	6.000	5.850	6.458
13	11.775	11.604	53.729	6.000	5.850	6.250
20	11.775	10.996	49.979	5.667	5.517	6.021
27	11.775	10.704	49.021	5.500	5.350	5.875
Oct.			CALENDAR WEEK AVERAGES			
2	12.317	12.025	56.708	6.00	5.85	6.750
9	11.983	11.783	55.333	6.00	5.85	6.333
16	11.775	11 413	51.813	5.90	5.75	6.125
23	11.775	10.813	49.458	5.50	5.35	6.000
30	11.671	10.588	48.313	5.50	5.35	5.750

SILVER, GOLD, AND STERLING EXCHANGE
NEW YORK AND LONDON

1937	Sterling Exchange "Check"	Sterling Exchange "90-day demand"	Silver New York	Silver London	Gold London	Gold United States
Oct.						
1	4.95250	4.94250	44.750	19.8125	140s 7½d	$35.00
2	4.95250	4.94375	(c)	19.8750	140s 6 d	35.00
4	4.95375	4.94500	44.750	19.9375	140s 6½d	35.00
5	4.95125	4.94250	44.750	19.9375	140s 8 d	35.00
6	4.95375	4.94625	44.750	19.8750	140s 7½d	35.00
7	4.95250	4.94500	44.750	19.9375	140s 6½d	35.00
8	4.95250	4.94500	44.750	20.0000	140s 6½d	35.00
9	4.95250	4.94625	(c)	20.0625	140s 6½d	35.00
11	4.95250	4.94500	44.750	20.0625	140s 6½d	35.00
12	Holiday	Holiday	Holiday	19.9375	140s 4½d	35.00
13	4.95625	4.94875	44.750	19.9375	140s 4 d	35.00
14	4.96000	4.95250	44.750	19.9375	140s 4 d	35.00
15	4.96000	4.95250	44.750	20.0000	140s 4½d	35.00
16	4.95625	4.95000	(c)	19.9375	140s 4 d	35.00
18	4.95625	4.94750	44.750	20.0000	140s 4½d	35.00
19	4.95375	4.94500	44.750	20.0000	140s 5½d	35.00
20	4.95125	4.94250	44.750	20.0000	140s 6½d	35.00
21	4.95125	4.94250	44.750	19.9375	140s 7 d	35.00
22	4.95000	4.94250	44.750	19.8750	140s 8 d	35.00
23	4.95000	4.94250	(c)	19.8750	140s 8 d	35.00
25	4.95000	4.94250	44.750	19.9375	140s 7½d	35.00
26	4.95000	4.94250	44.750	19.9375	140s 7 d	35.00
27	4.95125	4.94375	44.750	19.9375	140s 8 d	35.00
28	4.95375	4.94625	44.750	19.9375	140s 7 d	35.00
29	4.96375	4.95625	44.750	19.9375	140s 6½d	35.00
30	4.96125	4.95375	(c)	19.8750	140s 4½d	35.00
Average for month	4.95395	.....	44.750	19.942	.....	35.00
			AVERAGES FOR WEEK			
Oct.						
6	4.95208	.....	44.750	.....	.....	.....
13	4.95325	.....	44.750	.....	.....	.....
20	4.95625	.....	44.750	.....	.....	.....
27	4.95042	.....	44.750	.....	.....	.....

Calendar week averages: New York Silver, 2nd, 44.750; 9th, 44.750; 16, 44.750; 23rd, 44.750; 30th, 44.750.
(c) No quotation (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis, add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.300c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order issued April 24, 1935, the U. S. Government's price on newly mined domestic silver was established at 77.57. Handy & Harman's quotation for domestic silver, .999 fine, was 77c. per ounce throughout October.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1937 Oct.	COPPER Standard Spot	COPPER Standard 3 months	COPPER Electro Bid	TIN Standard Spot	TIN Standard 3 months	LEAD Spot Buyers	LEAD Spot Sellers	LEAD 3 months Buyers	LEAD 3 months Sellers	ZINC Spot Buyers	ZINC Spot Sellers	ZINC 3 months Buyers	ZINC 3 months Sellers
1	48.9375	48.8750	54.0000	242.7500	241.5000	19.1875	19.2500	19.2500	19.3125	19.2500	19.3125	19.5000	19.5625
4	50.1250	50.1250	55.0000	250.0000	248.6250	19.5625	19.6875	19.6875	19.7500	19.8125	19.8750	20.0625	20.1250
5	48.6250	48.5000	54.0000	242.5000	241.2500	19.1875	19.3125	19.3750	19.4375	19.0000	19.0625	19.2500	19.3125
6	45.6250	45.7500	52.0000	233.2500	232.0000	17.8125	17.8750	18.0625	18.1250	17.6250	17.7500	17.8750	17.9375
7	47.7500	47.7500	52.5000	240.7500	239.5000	18.3125	18.3750	18.5625	18.6250	18.1875	18.2500	18.4375	18.5000
8	46.6250	46.8125	52.0000	237.7500	236.5000	17.8750	18.0000	18.0000	18.1250	17.8750	18.0000	18.1250	18.2500
11	46.5000	46.7500	53.0000	234.7500	233.5000	18.2500	18.3750	18.4375	18.5000	18.1250	18.1875	18.3125	18.3750
12	46.4375	46.6250	53.0000	230.2500	229.0000	18.1250	18.1875	18.3125	18.3750	17.8125	17.8750	18.0625	18.1250
13	45.6250	45.8750	51.5000	224.0000	223.0000	18.0000	18.0625	18.0625	18.1250	17.7500	17.8750	18.0625	18.1250
14	45.3750	45.6250	51.5000	226.5000	225.2500	18.0000	18.0625	18.0625	18.1250	17.8750	17.9375	18.1250	18.1875
15	45.4375	45.6875	50.5000	222.5000	221.7500	18.0000	18.0625	18.1250	18.1875	17.6875	17.7500	17.9375	18.0000
18	45.3750	45.6875	50.5000	219.7500	219.0000	18.1250	18.1875	18.1875	18.2500	17.5625	17.6875	17.8750	17.9375
19	42.5000	42.7500	47.0000	206.5000	206.5000	17.5000	17.6250	17.5000	17.6250	16.6875	16.7500	17.0000	17.0625
20	43.3750	43.6250	48.0000	210.5000	210.5000	17.6875	17.7500	17.6875	17.7500	16.6875	16.8125	16.9375	17.0000
21	44.9375	45.1875	49.0000	222.5000	222.0000	18.2500	18.3750	18.2500	18.3750	17.3125	17.4375	17.6250	17.6875
22	45.0000	45.3125	49.0000	218.7500	218.5000	18.5625	18.6250	18.5625	18.6250	17.5000	17.5625	17.7500	17.8125
25	42.3750	42.7500	48.0000	204.5000	204.5000	17.4375	17.5000	17.3750	17.4375	16.3125	16.3750	16.5625	16.6250
26	43.3125	43.6875	49.0000	208.5000	208.5000	18.0625	18.1250	18.0000	18.0625	17.0625	17.1875	17.2500	17.3125
27	42.4375	42.8125	47.5000	206.0000	206.0000	17.8125	17.8750	17.7500	17.8125	16.8125	16.8750	16.9375	17.0000
28	43.5000	43.8125	48.0000	209.7500	209.7500	18.5000	18.6250	18.4375	18.5000	17.3125	17.4375	17.5625	17.6250
29	43.1875	43.5000	48.0000	209.5000	209.5000	18.3125	18.3750	18.2500	18.3125	17.0000	17.0625	17.1250	17.1875
Av'ge for month	45.384	.....	50.619	223.869	.....	18.259		18.318		17.722		17.955	

Prices for lead and zinc are the official prices for the first session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton of 2,240 lb.

CURRENT PRICES—MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(November 1, 1937)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	20c.
Antimony, domestic, spot, lb	17.250c.
Bismuth, ton lots, lb	$1.00
Cadmium, lb	$1.25 @$1.60
Calcium, lb., ton lots 98 @ 99 per cent	75c.
Chromium, 97 per cent grade, lb	85c.
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	30c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$46.00
Quicksilver, flask of 76 lb., 100 flasks or more	$85.00@$86.00
Radium, mg. radium content	$40.00
Selenium, 99.5 per cent, lb	$2.00
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75@$2.00
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$6.00
Zirconium, commercially pure, lb	$7.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 45 @ 47 per cent, c.i.f. Atl. ports, long ton	$21.00@$22.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$5.25
Mesabi bessemer	$5.10
Old Range non-bessemer	$5.10
Mesabi, non-bessemer	$4.95
Lead (Galena) 80 per cent Joplin, Mo., ton	$63.42
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52 @ 55 per cent	50c.
50 @ 52 per cent	50c.
44 @ 48 per cent	44c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	a$27.00@$29.00
Domestic Scheelite	a$25.00@$27.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$37.00

(a) Nominal.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3c
Cobalt Oxide, 70 @ 71 per cent, lb	$1.67@$1.77
Copper Sulphate, 100 lb	$4.75
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.34
Sodium Sulphate, bulk, ton	$13.00@$15.00

ALLOYS

Beryllium Copper, Master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$23.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb	10½c.
Ferromanganese, 78 @ 82 per cent, gross ton	$102.50
Ferromolybdenum, 50 @ 60 per cent Mo, lb. of Mo contained	95c.
Ferrosilicon, 50 per cent, gross ton	$69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	Nominal

NON-METALLIC MINERALS

Asbestos, f.o.b. mines ton:	
Canadian (Quebec)	
Crude No. 1	$550@$600
Crude No. 2	$200@$225
Spinning fibers	$90@$170
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$47.50.....
Paper stock	$35 @.....
Cement stock	$23 @.....
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 90 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$7.00
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$6.50@$7.50
Domestic, abrasive, 70 @ 84 per cent	$12.50@$15.00
Dalmatian, 50 @ 55 per cent	(a)$6.50@$7.50
French, 56 @ 59 per cent	(a)$8.00@ 9.00
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$6.50@$8.50
Delaware, No. 1	$14.50@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$20.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00@.....
Dead-burned, f.o.b. Washington	$25.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in	15@40c.
2 x 2 in	30@60c.
3 x 3 in	75@$1.20
3 x 4 in	$1.00@$1.40
4 x 6 in	$2.00@$2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@12½c
Silica, water-floated, in bags, 325 mesh, ton	$16.00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$9.00@ $9.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$15.00@.....
200 mesh, cream colored	$25.00@.....

(a) Nominal.

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$24.50
Basic	$23.50
No. 2 Foundry	$24.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$37.00
Structural shapes, 100 lb	$2.25
Bars, 100 lb	$2.45

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1936	1937	1936	1937	1936	1937
January	47.250	44.913	20.250	20.734	496.115	490.670
February	44.750	44.750	19.796	20.083	499.908	489.307
March	44.750	45.130	19.663	20.677	496.952	488.412
April	44.892	45.460	20.245	20.740	494.139	491.524
May	44.869	45.025	20.248	20.346	496.850	493.835
June	44.750	44.818	19.770	20.022	501.817	493.404
July	44.750	44.750	19.590	19.986	502.178	496.582
August	44.750	44.750	19.490	19.848	502.519	498.043
September	44.750	44.750	19.579	19.889	503.455	495.145
October	44.750	44.750	19.977	19.942	489.755	495 395
November	45.431	.....	21.050	.....	488.727	.....
December	45.352	.....	21.238	.....	490.670	.....
Year	45.087	.....	20.075	.....	496.924	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		(a) Electrolytic	
	1936	1937	1936	1937	1936	1937	1936	1937
January	9.025	12.415	8.358	12.112	34.706	51.497	38.788	56.497
February	9.025	13.427	8.566	13.828	35.313	59.225	39.463	64.013
March	9.025	15.775	8.708	16.590	36.040	72.339	40.227	76.167
April	9.169	15.121	8.849	14.692	36.975	62.506	41.131	66.614
May	9.275	13.775	8.819	13.999	36.690	61.118	40.839	63.684
June	9.275	13.775	8.790	13.492	36.324	55.696	40.357	61.409
July	9.352	13.775	8.993	13.817	37.217	56.412	41.228	62.807
August	9.525	13.775	9.297	13.926	38.259	57.143	42.375	63.595
September	9.525	13.530	9.523	12.984	38.915	52.989	43.267	58.966
October	9.563	11.838	9.669	11.207	40.980	45.384	45.295	50.619
November	10.161	.....	10.349	.....	43.932	.....	48.467	.....
December	10.763	.....	10.835	.....	45.946	.....	50.364	.....
Year	9.474	.....	9.230	.....	38.441	.....	42.650	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation

LEAD

	New York		St. Louis		London			
	1936	1937	1936	1937	1936 Spot	1936 3 Mos.	1937 Spot	1937 3 Mos.
January	4.500	6.000	4.350	5.850	15.397	15.494	27.272	27.150
February	4.515	6.239	4.365	6.089	16.022	16.141	28.319	28.328
March	4.600	7.190	4.450	7.040	16.608	16.767	33.027	32.979
April	4.600	6.175	4.450	6.025	16.097	16.234	26.014	25.878
May	4.600	6.000	4.450	5.850	15.530	15.601	24.000	23.891
June	4.600	6.000	4.450	5.850	15.170	15.259	22.878	22.759
July	4.600	6.000	4.450	5.850	15.856	15.954	23.932	23.703
August	4.600	6.452	4.450	6.302	16.772	16.859	22.606	22.670
September	4.600	6.400	4.450	6.250	18.009	17.974	20.990	21.044
October	4.631	5.740	4.488	5.590	18.446	18.375	18.259	18.318
November	5.114	.....	4.964	.....	21.723	21.693	.....	.....
December	5.554	.....	5.406	.....	25.560	25.503	.....	.....
Year	4.710	.....	4.560	.....	17.599	17.655	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

TIN

	Straits New York		Standard, Spot London	
	1936	1937	1936	1937
January	47.234	50.925	209.731	229.350
February	47.962	52.010	207.081	233.750
March	48.037	63.043	213.080	282 988
April	46 963	59.172	209.313	267.136
May	46.352	55.651	202.429	250.645
June	42.204	55.851	183.167	249.852
July	43.021	59.245	185.957	263.540
August	42.579	59.465	183.731	264.595
September	44.754	58.675	194.676	258.943
October	44.975	51.654	201.193	223.869
November	51.392	.....	230.869	.....
December	51.823	.....	232.108	.....
Year	46.441	.....	204.445	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1936	1937	1936 Spot	1936 3 Mos.	1937 Spot	1937 3 Mos.
January	4.848	5.847	14.488	14.719	21.153	21.281
February	4.859	6.465	15.125	15.391	25.122	25.322
March	4.900	7.381	159.83	16.190	33.188	33.405
April	4.900	7.010	15.181	15.334	26.216	26.344
May	4.900	6.750	14.536	14.777	23.092	23.365
June	4.880	6.750	13.896	14.122	21.409	21.528
July	4.783	6.923	13.579	13.826	22.568	22.693
August	4.800	7.192	13.528	13.759	24.140	24.290
September	4.850	7.190	13.906	14.159	21.406	21.607
October	4.850	6.085	14.554	14.835	17.722	17.955
November	4.974	.....	16.301	16.554	.....	.....
December	5.273	.....	17.957	18.145	.....	.....
Year	4.901	.....	14.920	15.151	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1936	1937	1936	1937
January	105.000	90.000	20.000	19.500
February	105.000	90.000	20.000	19.500
March	105.000	101.667	20.000	20.000
April	105.000	105.000	20.000	20.000
May	105.000	105.000	20.000	20.000
June	105.000	130.962	20.000	20.000
July	93.462	142.500	20.000	20.000
August	90.000	142.500	20.000	20.000
September	90.000	142.500	20.000	20.000
October	90.000	142.500	20.000	20.000
November	90.000	.....	20.000	.....
December	90.000	.....	20.000	.....
Year	97.789	.....	20.000	.....

Aluminum in cents per pound, 99 per cent grade. Cadmium, cents per pound.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1936	1937	1936	1937	1936	1937
January	12.736	14.130	76.769	90.250	36.885	50.404
February	12.967	14.563	77.000	91.000	35.000	64.360
March	13.072	16.375	77.000	91.778	34.115	58.000
April	12.673	16.043	76.731	92.000	32.846	58 000
May	12.410	14.830	74.940	95.520	32.000	54.800
June	11.707	14.702	74.192	96.654	36.346	53.000
July	11.245	14.803	73.423	93 904	39.308	50.115
August	11.125	15.327	73.923	91 423	49.577	51.000
September	11.740	16.555	85.280	89.020	68.960	51.000
October	12.058	16.935	89.240	86.140	54 074	48.560
November	12.233	.....	90.250	.....	48 000	.
December	12.918	.....	90.250	.....	48 000	.....
Year	12.240	.....	79.917	.....	42.926	....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1936	1937	1936	1937	1936	1937
January	20.00	21.50	19.00	20.50	19.50	21 00
February	20.00	21.50	19.00	20.50	19.50	21.00
March	20.00	24.50	19.00	23.20	19.50	23.70
April	20.00	24.50	19.00	23.50	19.50	24.00
May	20.00	24.50	19.00	23.50	19.50	24.00
June	20.00	24.50	19 00	23.50	19.50	24 00
July	20.00	24.50	19.00	23.50	19.50	24.00
August	20.00	24.50	19.00	23.50	19.50	24 00
September	20.00	24.50	19.00	23.50	19.50	24.00
October	20.00	24.50	19.00	23.50	19.50	24.00
November	20.23	.....	19.23	.....	19.73	.....
December	21.00	.....	20.00	.....	20.50	.. ..
Year	20.103	.....	19.103	.....	19.603	....

Iron in dollars per long ton. F. o. b. Mahoning and Shenango Valley furnaces.

News OF THE INDUSTRY

Sino-Japanese Conflict Stimulates Demand for Philippine Metals

Production of copper, lead, chrome, and iron ores increasing, with Japan contracting for good share of output—Island's gold industry adds new producers

ACTIVITY in the base-metal industry of the Philippines has been increased considerably by the hostilities between Japan and China. During July, 62,823 tons of iron ore, valued at 296,473 pesos, were shipped to Japan; the output for July, 1936, was 55,362 tons, worth 251,970 pesos. A new iron mine will go into production early in 1938, and all of its output has been contracted by Japanese firms. This mine is operated by the Samar Mining Company, and is the first producer of the Elizalde interests. Production will start at 18,000 tons a month and will be rapidly increased to 30,000 tons. Chrome ore exports have increased substantially, with practically all of the production being shipped to the United States. July output was 10,597 long tons, valued at 213,950 pesos, compared with 1,117 tons, valued at 27,000 pesos, for July last year. Base-metal exports for the first six months of 1937 totaled 336,394 tons, valued at 1,856,100 pesos, of which the greater part was iron ore sent to Japan. Iron-ore shipments amounted to 315,907 tons, valued at 1,399,570 pesos, of which 314,433 tons, valued at 1,384,000 pesos, was shipped to Japanese consumers, and 1,473 tons, valued at 15,550 pesos, was sent to the United States. A total of 17,201 tons of chromite ore, valued at 337,054 pesos, was shipped to the following countries: United States, 14,347 tons, valued at 249,934 pesos; Japan, 2,548 tons, valued at 77,410 pesos; Sweden, 202 tons, valued at 8,080 pesos; Belgium, 103 tons, valued at 1,530 pesos, and 100 pesos worth was sent to Hongkong. Japan bought 3,057 tons of copper ore, valued at 97,216 pesos, twenty-three tons of lead ore, valued at 2,700 pesos, and 204 tons of manganese ore valued at 2,020 pesos during the first half of the year.

▶ The addition of four new milling plants to the list of Philippine gold producers has featured activities of the past two months. Three other plants are under construction and a new placer has been brought into production. A new large dredge was recently launched, and another is now on the ways in Manila. Expansion programs at many of the larger producers have been completed, and increased gold output is expected. Monthly gold production this year has averaged about 4,200,000 pesos; and output in the last four months of the year should raise this figure substantially. The year's output from Jan. 1 to Aug. 31 inclusive was approximately 33,000,000 pesos, compared to 26,276,320 pesos for the same period last year.

▶ Mindanao Mother Lode started operations at its 200-ton flotation-cyanidation plant late in August. This is the second plant on the Island of Mindanao (the other being East Mindanao). This plant was built by the Engineering Equipment & Supply Company of Manila, managers and operators of the property, following a development program of fourteen months. Ore reserves are estimated at 131,176 tons, averaging 33.52 pesos per ton.

▶ Lepanto Consolidated started shipping copper-gold concentrates to the United States in September from the company's 300-ton flotation mill, that treats ore running from 1 to 3 per cent copper and around 2.70 pesos in gold. The plant, built by Nielson and Company, is in the Mankayan district 100 km. north of Baguio.

▶ Mineral Resources started production at its new 150-ton flotation plant early in October. The plant was built in less than 5½ months, by Southwestern Engineering Company of P. I., Inc. The ore is a zinc-lead-gold occurrence and heads run 6.1 per cent combined lead and zinc and around 10 pesos in gold. The plant is on Marinduque Island, about 175 km. southwest of Manila.

▶ Balatoc Mining Company declared a 50 per cent stock dividend, payable on Oct. 1, thus increasing its capitalization to 6,000,000 pesos. In addition to this extra dividend, a regular third-quarter dividend of 0.40 pesos per share was paid on Oct. 1. Benguet Consolidated will pay 0.25 pesos a share for the third quarter.

▶ Twin Rivers Gold Company has reported a gold production valued at 35,000 pesos from the company's 1,500-ton tailings plant in the Baguio district, representing trial runs. This plant is the first tailings plant in the Philippines, and will soon reach its full capacity.

▶ Plans for a cooperative safety station are now being worked out by the operators in the Baguio district. S. M. Jarrett, safety engineer of Benguet Con-

The Mindanao Mother Lode 200-ton flotation-cyanidation plant on the Island of Mindanao. This is the second mill on the Island of Mindanao

▶PHILIPPINES

solidated and its interests, is preparing preliminary plans for the station, with the cooperaton of Andrew Leith, of the Bureau of Mines. That every operator in the district may have available complete apparatus and the services of trained men, the plan of a safety station to be located at a central point in Baguio has been adopted.

▶ Mindanao Mining is operating a dragline-dredge plant in the southern part of Mindanao, and adjustments were made in October for 24-hour operation, handling between 60,000 to 80,000 cu. yd. a month.

▶ Surigao Consolidated has started construction of a 150-ton plant in Mindanao; Santa Rosa and Tumbaga Mining are building mills in the Paracale-Mambualo district.

▶ The "Mary Angus," first of the two 8-cu. ft. close-connected bucket-type dredges ordered for Coco Grove, Inc., was launched on Sept. 2, and is now in Paracale Bay, where installation of gold-saving equipment is being completed. Operations are expected to start late in November. Capacity of the dredge is about 225,000 cu. yd. per month. Work on the second dredge is under way in Manila, and it will be launched in November. Both dredges are of Bucyrus-Erie manufacture, and were ordered through the Manila Machinery & Supply Company of Manila.

California

Larger Mill for Zeibright Mine

Finished plant can treat 1,000 tons daily—New placer units installed in Happy Camp mining area—Recently completed mills start at Lost Mormon and Total Wreck properties

▶ With eighteen men employed on two shifts, the French Hill Mining Company, R. I. Johnston, president, is successfully working two channels of the Boulder placer mine, near Pilot Hill. The gravel is mined by a power shovel, and a bulldozer delivers it to a hopper discharging onto a 250-ft. conveyor belt leading to a trommel. Undersize is treated successively in a riffle box, two jigs, a second set of riffles, a pulsating jig, and another long riffle box. A recovery of 90 per cent is said to be obtained with this layout. Coarse material from the trommel is removed by a stacker. To handle gravel too hard to be broken by the trommel, the company plans to install a rod mill ahead of the two jigs; also an amalgamation barrel after the pulsating or cleanup jig. The property comprises about 30 acres, and a six months' operation is indicated. After this the equipment will be moved to the gravel mine the company owns in the Greenwood district near the Sliger mine, where a considerable yardage of profitable gravel is available.

▶ Enlargement of the mill at the Zeibright mine, near Emigrant Gap, has been completed and the management expects to be treating 1,000 tons of ore a day. At the mine, sinking of the 450-ft. main shaft to greater depth is planned. The property is a subsidiary of Empire Star Mines Company, Ltd., with Robert Hendricks, superintendent, in charge of operations.

▶ Reconditioning of the mill at the Golden Triangle mine, near Granitville, has been started, and the improved plant is scheduled to be ready for operation before winter sets in. Mined ore is now trucked to a custom mill. Arrangements are also being made to sink the 140-ft. shaft deeper and drift south to develop additional ore. W. W. Esterly is manager.

▶ Neal Hayden has placed in operation the 50-ton mill at the Lost Mormon mine, situated in the New York Mountains, about 15 miles east of Lanfair, San Bernardino County. Since reopening of the property last fall, considerable underground work, including retimbering of the 320-ft. shaft to the 150-ft. level, has been done.

▶ Belmont Osborn Mining Company is reported to have completed arrangements for leasing the 300-ton mill available at its property near Angels Camp to J. H. Kann, who is operating the Gold Ridge mine, near Jamestown, under lease. The lessee is required to pay a 10 per cent royalty out of the gross recoveries made and operating expenses of the mill. California Osborn Mining Company is to receive a part of the income for the use of its equipment. In the meantime, Belmont Osborn will continue development work in the mine. Production from the Gold Ridge property will be trucked to the Belmont Osborn mill, which may be operated at capacity.

▶ A 25-ton mill has recently been placed in operation by the Total Wreck Redemption Company, G. P. Meyers, president, at its Total Wreck and Last Chance properties, near Murphys.

▶ In the Happy Camp mining area, Siskiyou County, the Forest Moore placer mine is being equipped with a steam shovel and washing plant, and production is to commence early in November. The property is operated by Elmer Olsen and associates. Similar equipment has been installed at the Muck-a-Muck mine, where D. Bradford is in charge of operations. At the Classic Hill mine, development continues under the direcion of A. C. Hahn, and a five-year lease is reported to have been taken by J. E. Merriam, Bedford Hills, N. Y., on the Buzzard Hill and Independence mines, owned by Buzzard Hill Mine, Inc. A 20-ton cyanide plant is under construction at the Buzzard Hill mine, with operations scheduled to start in December. The Independence mine is expected to be reopened early next summer. P. M. Toleman, superintendent, is in charge of operations.

Arizona

Mill Construction Continues In Various Districts

Tailings plant being erected by Congress Mining Corporation—Larger mill for Gold King Mines

▶ About 450,000 tons of tailings at the Congress mine, near Congress Junction, will be treated by a 200-ton cyanide plant now under construction by the Congress Mining Corporation. The company has been granted an RFC loan of $140,000 for development. It is headed by John G. Schork, 100 Broadway, New York City. Landon F. Stoebel, of Congress, is general manager.

▶ The capacity of the 60-ton flotation plant of the Gold King Mines, Inc., at Kirkland, is to be increased to 200 tons daily. Steady shipments of concentrates have been going forward to the International Smelter at Miami. Extensive development were started Sept. 1 to meet the increased mill demand. C. W. Tilton, of Roswell, N. M., is president of the company, with offices at 318 Security Building, Phoenix, Ariz. A. T. Russell, of Kirkland, is secretary and general manager.

▶ Plans are under way for the introduction of electric power through a transmission line from the United States Government project on the Gila River, and in this event the present 160 hp. diesel engine at the Bunker Hill and Arizona Mining Company, at Sombrero Butte, will be held in reserve for emergencies and the new source of power used. Ore already broken and in sight assure steady operation of the new mill recently completed. E. R. Anderson is vice-president of the company.

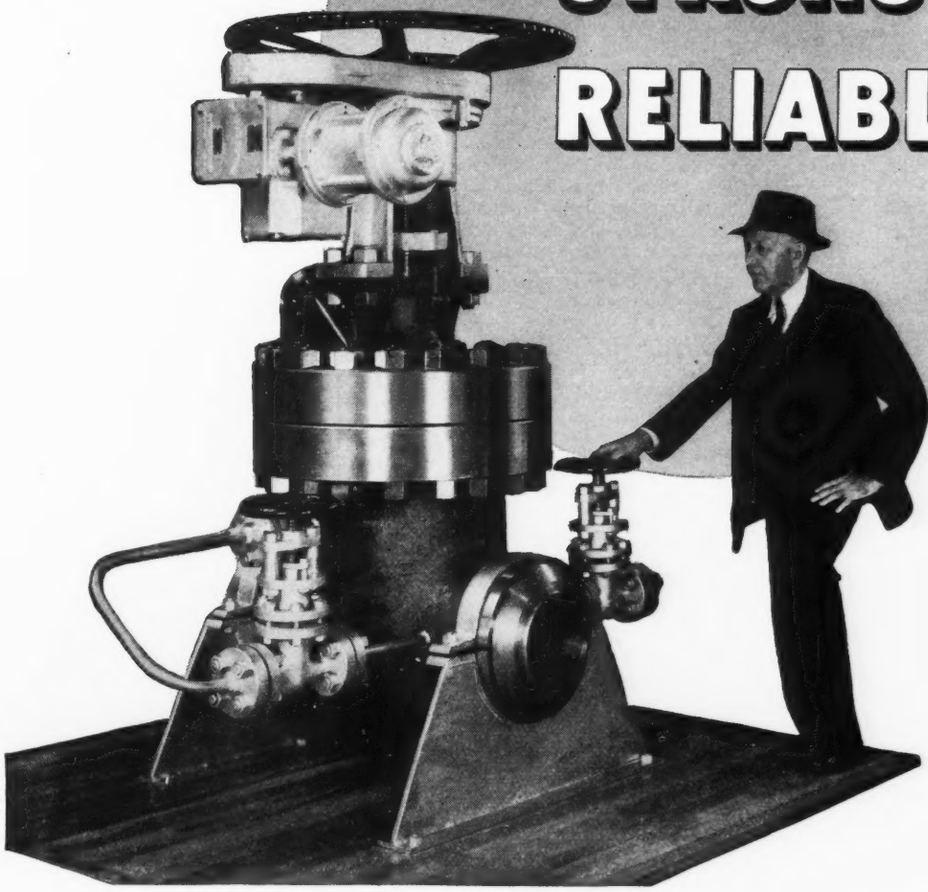
▶ The Inspiration Placers, Inc., at Bowie, have a crew of eight men working and are handling approximately 300 yards of gravel per day. The ground is being worked by dragline, and gold is recovered in riffles. The company is headed by R. J. Parker, of Chicago. F. J. Panknin, of Bowie, is superintendent.

▶ B. R. Ferrell has equipped a 25-ton mill at the Ray Southern mine, near Ray, for concentrating ore containing molybdenum, gold, and silver, and good recovery is recorded in present operations. Mr. Ferrell is planning to increase plant capacity, as ore reserves are increasing.

▶ Tungsten Reef mine, at Hereford, under lease and bond to J. J. Seeman, is producing about 100 tons of scheelite ore monthly. The ore is concentrated at a small mill at the mine, where eight men are employed. The plant is producing from 1,700 to 2,000 lb. of tungsten concentrates monthly.

▶ The 120-ft. shaft on the property of the "94" Mining Company, Inc., at

BIG STRONG AND RELIABLE



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▶ARIZONA

Crown King, is being unwatered and will be sunk to the 200 level, where lateral work is contemplated. The company is operating the Union and Eagle claims, a part of the Saratoga group which are under lease from the Phoenix-Saratoga Mining Company.

▶ Several new flotation cells and a filter have been recently installed in the plant of the General Ores Reduction Company at Chloride. This custom plant had been steadily operated since its construction nearly a year ago. Many small developments in the Cerbat Mountains are contributing to the mill supply. C. A. Ferrin, of Chloride, is general manager.

▶ Over 900 men are employed at the smelter division of the Copper Queen Branch of the Phelps Dodge Corporation, at Douglas, under the direction of H. A. Clark, manager. Wages of miners were recently reduced 5 per cent according to the sliding scale based on the price of copper. The Copper Queen Branch of the Phelps Dodge Corporation at Bisbee has a crew of nearly 2,000 men employed, and the daily production is averaging around 2,000 tons of copper ore. Operations of the property are directed by I. H. Barkdoll, general superintendent.

▶ The Coconino Copper & Chemical Company, of Flagstaff, is completing the last 20 miles of road to its properties 110 miles northeast of Flagstaff. Most of the machinery has arrived at Flagstaff. The company has acquired a large deposit of copper-impregnated sandstone first discovered about 1884. Stuart H. Ingram, manager, reports 20, 10, and 5 per cent copper ore and large quantities of 2 per cent ore. Ingram claims to have worked out a process which the company will use to produce a copper sulphate.

▶ Veta Mines Corporation, at Duncan, is producing approximately 200 tons of gold-silver ore daily, which is being treated in the company's flotation mill. At present 138 men are employed on the property. Robert H. Sayre, 507 Boston Building, Denver, Colo., is president and general manager. I. Partinan is general superintendent.

▶ At the present rate of production, the Tom Reed Gold Mines, at Oatman; the United States Smelting & Refining Company, at Gold Road, and the Gold Standard mines, at Katherine, all in Mohave County, will each produce in excess of a million dollars in gold bullion for the year. Many smaller producers in the county will also account for increased gold production of the county.

▶ Ore shipments have been started from the Albatross mine, at Arivaca. New roads have been built and new mine equipment has been installed and an active season is planned. E. LeRoy Blessing, 310 Olsen Building, Lockport, N. Y., is president of the Albatross Gold Mines, Inc., operating the property. Dr. G. Wallace Walker, consulting engineer, is in charge of the property.

▶ The new 50-ton flotation plant at the Mocking Bird mine, 20 miles northwest of Chloride, is operating steadily on both dump and mine ores, with satisfactory results. T. J. Slaughter is superintendent. The operating group is headed by J. K. Houssels and associates, of Las Vegas, Nev.

▶ Magma Copper Company reports it produced 22,586,761 lb. of copper for nine months this year ending Sept. 30, and that fourth-quarter production has been sold at an average price in excess of that for any previous quarter of 1937.

▶ The United Eastern property at Oatman, operated by the Oatman Associates Company, has resumed the shipment of ores to the Telluride mill of Johnson & Wicher Mines, Inc. The company is headed by J. L. McIvor, president and general manager.

Nevada

Development on Comstock Lode Reveals Good Ore

Satisfactory results obtained from work on orebody in Overman mine—High grade ore found by South Comstock Gold Mines, Inc.—Tungsten Mines, Inc., starts new mill

▶ A shoot of high-grade ore has been developed from the 300- to the 400-ft. level by the South Comstock Gold Mines, Inc., at Silver City, in the southeastern extremity of the Comstock district. Sampling from $100 to $400 per ton, the ore is being stoped over a width of 4 to 8 ft. Beyond this rich ore the vein filling is of good mill grade for a length of 800 ft. The flotation mill is treating 45 to 50 tons per day, with recovery of 90 to 94 per cent. E. W. Harker is manager.

▶ An orebody opened in extending old tunnel workings on the Overman mine of the Consolidated Chollar, Gould & Savage Company at Gold Hill, near the south end of the Comstock lode, is assuming large proportions according to latest reports. Drifts and crosscuts on the 40-, 100-, and 200-ft. levels below the adit level are said to have shown continuous ore for over 500 ft. in length on the 100 level, from 25 to 35 ft. in width, and ranging in value, chiefly gold, from $10 per ton on the upper level to $30 on the lowest level. The orebody appears never to have been opened in early work in this area. The Overman shaft is being repaired in preparation for driving crosscuts on lower levels under the tunnel workings. Sidney W. Fish, of Carmel, Calif., formerly of New York, is president; Thomas V. Barton, of San Francisco, is managing director, and F. V. Dempsey, of Gold Hill, is manager. The flotation mill is now treating about 400 tons of ore daily.

▶ Silver-lead ore of high grade is being shipped to the A. S. & R. Garfield smelter in Utah by the Olympus Mining & Milling Company from the old camp of Freiberg, in northwestern Lincoln County. The ore is trucked 75 miles east to Caliente, nearest rail point. The district has been neglected for some years because of bad roads that lately have been repaired by the county. James Petrulas, a director of the company, is manager, with offices in Salt Lake City.

▶ On behalf of the Como Mines Company, for which he is trustee in bankruptcy, Dryden Kuser, of Reno, formerly a New Jersey State Senator, recently filed a petition in the Federal district court at Carson City, approved later by Judge Frank H. Norcross, seeking to reorganize the company under the provisions of Sec. 77b of the Federal bankruptcy act. Following extended development and construction of a 300-ton flotation mill, the company ceased to operate in mid-1936. It was indicated that the mill equipment may be sold, as metal recovery by flotation has not been satisfactory. Reorganization, probably involving an exchange of old shares for new in undetermined ratio, has been approved by all concerned, including the largest creditor, the St. Joe Consolidated Mines Corporation, with claims of some $80,000. Dryden Kuser is fiscal agent, with offices in Reno.

▶ The old Big Four mine, known also as the Lucky Girl, situated at the early-day silver-gold camp of Columbia, northern Elko County, is being reopened with encouraging results by Clark Wheeler and other Reno men. High-grade ore has been exposed in extending an old stope in tunnel workings. Roy Sunderland, Reno engineer, is in charge.

▶ In extending farther to the north its huge open cut on the outcrop of the Comstock lode, the Arizona Comstock Corporation has exposed a wide body of ore extending along the base of Mount Davidson and untouched by any of the old workings. Truck samples have had an assay value 50 to 100 per cent above the average product of the long pit, and metal production, in concentrate, bullion, and cyanide precipitate, has reflected the improvement in grade of mill feed. The flotation mill is treating over 400 tons per day, lower-grade concentrate is cyanided, and there is notable recovery of coarse gold in jigs or gold traps. W. J. Loring, president and managing director, is in active charge of all departments at Virginia City.

▶ Desert Silver, Inc., is said to be treating 220 tons of silver-gold ore per day in its lately completed cyanide mill at the Nivloc mine, 12 miles west of Silver Peak, in Esmeralda County. The mill was said to have a rated capacity of 175 tons per day. A large tonnage of mill ore has been developed to a depth of 900 ft. in an ore channel that in places is 100 ft. wide. Ira B. Joralemon is president and Frederick E. Gray is manager, with offices at Silver Peak.

▶ Molybdenum claims optioned from Lee F. Hand, of Tonopah, and situated in the Liberty district, Nye County, are being developed on a broad scale by

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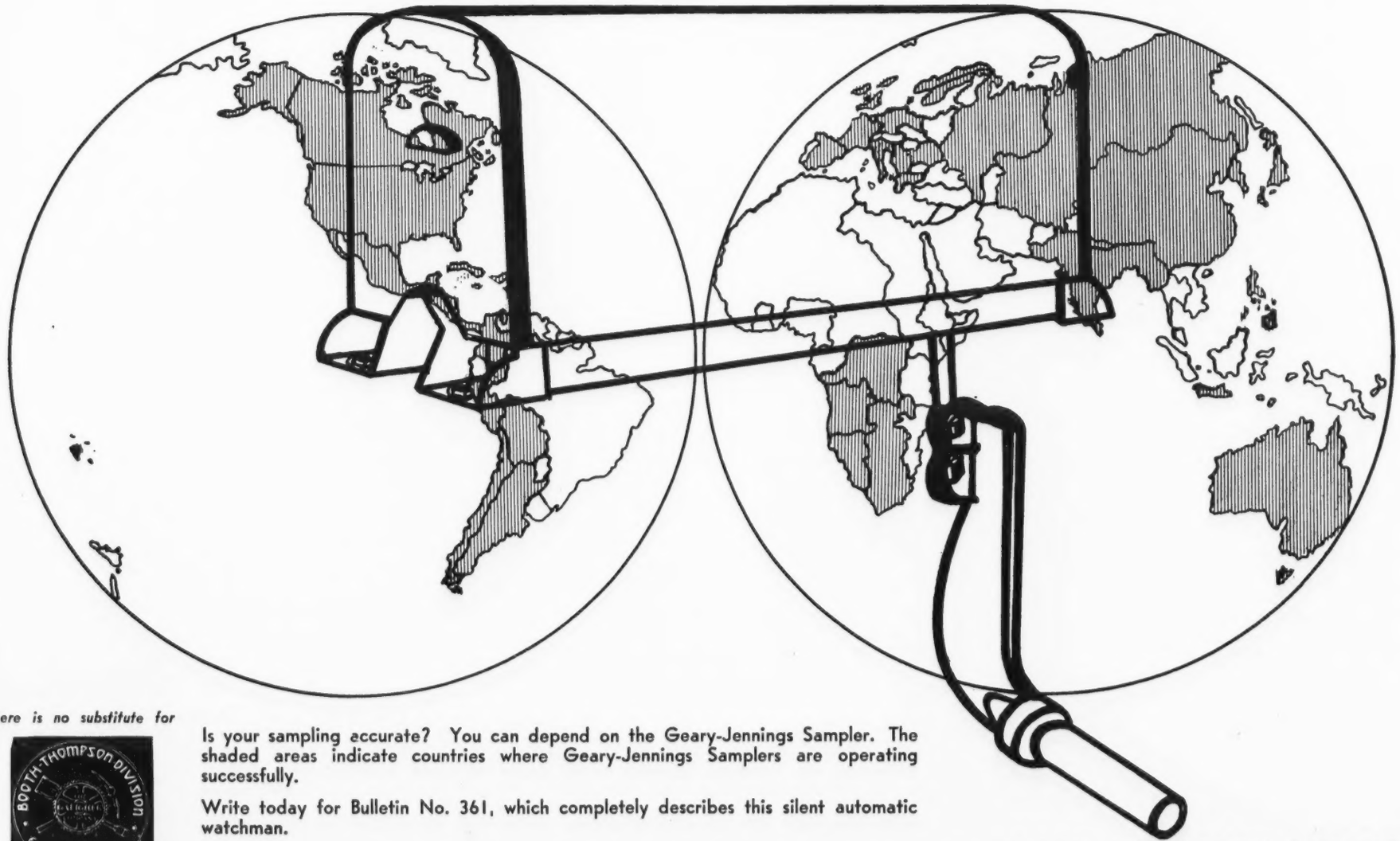

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▶NEVADA

the Union Carbide Company, with Clarence H. Hall, of Tonopah, in charge.

▶ The new mill of the Tungsten Mines, Inc., the Regan mining district, White Pine County, 90 miles east of Ely, is operating two shifts a day and producing an excellent grade of concentrate, according to S. W. Golding, vice-president. A primary crusher and one set of rolls have been installed at the portal of the tunnel to handle the ore as it comes out of the mine. The mill has been built at Mike Springs, 4 miles from the mine. Equipment consists of one set of rolls, four Wilfley tables, elevators, conveyors, and an electric generator operated by a 70 hp. Cummins diesel engine. The property, containing 29 claims, has been developed by test pits, shafts, and tunnels, proving three parallel veins carrying tungsten, gold, silver, lead, and zinc, Mr. Golding reports. The value of the ore ranges from $40 to $50 a ton, with pockets running as high as $300 a ton. Offices of the company are at 300 Boyd Park Building, Salt Lake City. C. D. Fox is president; Mr. Golding, vice-president; Clarence B. Reynolds, engineer and general manager; W. E. Stoker, secretary-treasurer.

▶ The Pioche-Kansas Mines, Inc., has been oganized by Salt Lake City men—George E. Coxe, Clark Kimball, and C. D. Fox—to develop property in the Pioche and Muncy Creek districts of Nevada. The company is concentrating on development of its Kansas claim, at Muncy Creek, 30 miles northeast of Ely, which has been leased from the Grand Deposit Consolidated Mines Company. A compressor has been installed and a bunkhouse built. A tunnel is being extended to connect with an old shaft in which ore is exposed.

▶ The Elkoro Mines Exploration Company has closed down its 125-ton cyanide mill and laid off miners, retaining a small maintenance crew. It was announced that a new shaft would be sunk and operation of the mill may be resumed in the spring. The mines produced several millions in gold when operated formerly by the Elkoro Mines Company, a subsidiary of the Yukon Gold Company. The mines are at high elevation and the camp, which is at Jarbidge, is often isolated in winter by heavy snows.

▶ Equipment added lately to the flotation mill of the Austin Silver Mining Company in the Austin or Reese River district includes a 5x6-ft. Dimon ball mill, a new gyratory crusher, a larger filter press, and four concentrate-drying pans. The flowsheet also embodies a jaw crusher, a duplex classifier, seven Fagergren cells, settling tanks, and a rotary dryer. The mill is treating around 100 tons per day, the ratio of concentration being from 30 to 35 tons to 1. Concentrate is transported by a 10-ton truck to the Garfield smelter. Ore is derived from the Jack Pot and Buffalo shafts, from old mine dumps, and from surface stope fills in the Littrell vein. It is the purpose later to work the rich Lander Hill area through the 6,000-ft. deep-level tunnel that drains all the old mines. Charles Sabin, of New York, is president of the Austin Silver Mining Company; Paul Klopstock is chairman of the board and J. P. Hart is manager at Austin.

▶ From sources usually reliable it is learned that a body of exceedingly rich ore has been opened by the Eastern Exploration Company, subsidiary of Calumet & Hecla Consolidated Copper, in the Grizzly Bear workings of the leased Goldfield Consolidated Mines property at Goldfield. The operating company has been shipping ore to smelters at the rate of a carload weekly. Paul Murphy is in charge at Goldfield.

▶ The Betty O'Neal silver-gold mine near Battle Mountain, in Lander County, which has paid substantial dividends, is to be reopened, and leases will be granted by the Gold and Silver Circle Mines, Inc., which owns the property and is operating its 75-ton cyanide mill at Midas, in the Gold Circle district, Elko County. C. W. Touzeau, vice-president, is directing the company's activities.

Colorado

Tungsten Mine Operators More Active

Rise and fall of price of tungsten ore creates uncertainty on reopening some mines in Boulder district—Idaho Spring and Georgetown camps active

▶ Jack Clark, president of Gold, Silver, and Tungsten, Inc., at Boulder, Colo., is reported to have opened up a good body of low-grade tungsten ore. This ore is easily treated, and will permit increased production at the mill in Boulder Canyon. The old tungsten field, around Nederlands and Rollinsville, has been very active, encouragement being brought on by rising prices obtained for tungsten ore. In the latter part of October, however, prices declined somewhat, but some old mines as well as a number of new properties are being operated and some are said to plan operations during the winter, providing ore prices are satisfactory.

▶ The installation of a new 2,000-cu. ft. compressor at the South London Mines, under the supervision of H. L. Tedrow, has steadily increased mine production. During summer months, the tailing pond is built up by regulated tailings flow that permits simple disposal during the winter months, so as to meet with the Colorado tailings law. Frank Kennicott is mine superintendent; C. F. Dandois mill superintendent, and Tony McDougal master mechanic.

▶ The London-Butte Mining Company, across the draw from the South London Mines, near Alma, Colo., is employing between 75 and 100 men in the mine and mill. George Schreiber is general superintendent; George Hartman, assistant general superintendent; George Baker master mechanic; Grant Anderson mill foreman; and William Travers, mine foreman. A substantial tonnage of milling ore has been blocked out, and selective mining is employed in spotty areas so as to maintain constant mill heads.

▶ The Empire Zinc Company of Colorado, at Gilman, continues mining a heavy tonnage of a copper-lead-silver ore, which is shipped to the Utah smelter. R. L. Jones is superintendent; Frank Maloit, mine foreman; and Tom Garnett, maintenance engineer. This mine can produce either lead-zinc ore or a lead-silver-copper ore separately, with low mining costs.

▶ La Veta Mines, Inc., at Telluride, has been continuing extensive development work, resulting in maintaining good mill heads. A large area of good ore, partially developed, exists on the property, and with milling facilities of nearly a thousand tons per day, the property has good prospects of becoming one of the leading producers in the State. Robert Sayre, of Denver, is general manager; Charles Glasgow, general superintendent; William Line, mine foreman; and J. Ferguson, mill foreman.

▶ Crystal Fluorspar Company, at Boulder, under the supervision of Mr. Zangari, is operating the old St. Joe Mining & Milling Company mill, treating non-metallics and obtaining high recovery and low cost. This mill is designed for gold and silver ores, or non-metallics.

▶ Alma-Lincoln Mining Company, at Idaho Springs, Colo., is treating about 100 tons of ore daily. This mill is divided into two sections—one mill of 100 tons (the new section) and the other 50 tons, daily. F. T. Biddle is mill superintendent, and Clyde Lyons, general superintendent. Joe Ruth is operating two shifts daily at his custom mill in this district, due to greater intake of custom ore. Weather conditions in this mining section make possible twelve months' continuous operations. United Gilpin Mines, Inc., at Central City, and the Gregory Bates Mining Company, at Blackhawk, are gold producers said to have developed good mill ore, and plan operations throughout the winter months.

▶ The Georgetown mining field continues with new activities weekly, with the return of many of the old operators. The Silver Leaf, on MacClellan Mountain, has been leased by Bennet and Rowe. Pulaski mine, on the western slope of Leavensworth Mountain, is now being worked; and the Hall Tunnel, in this same vicinity, has been driven to cut the Pulaski and other veins. New ore bins have been built on this property; and development work carried on will probably ultimately contact and cut the veins of the Colorado Central.

▶ The Griffith management has a ½-yd. steam shovel to facilitate the working over of the company's dump material which is being tested at the Commonwealth mill.

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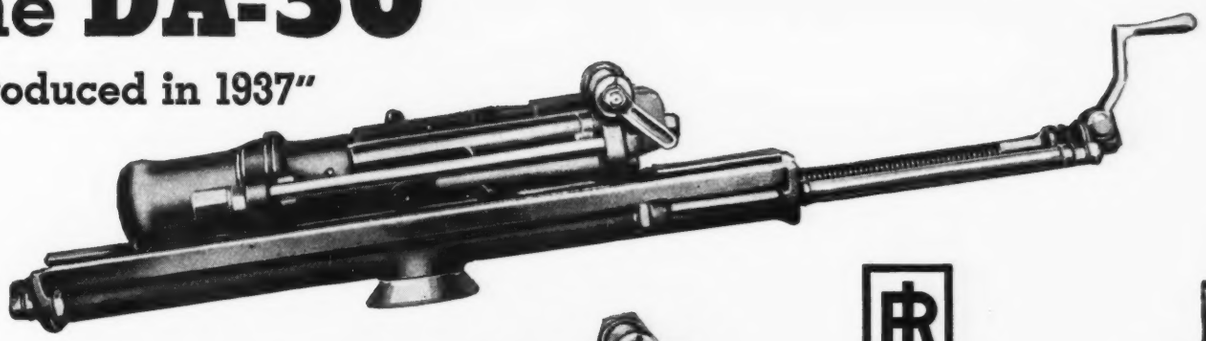

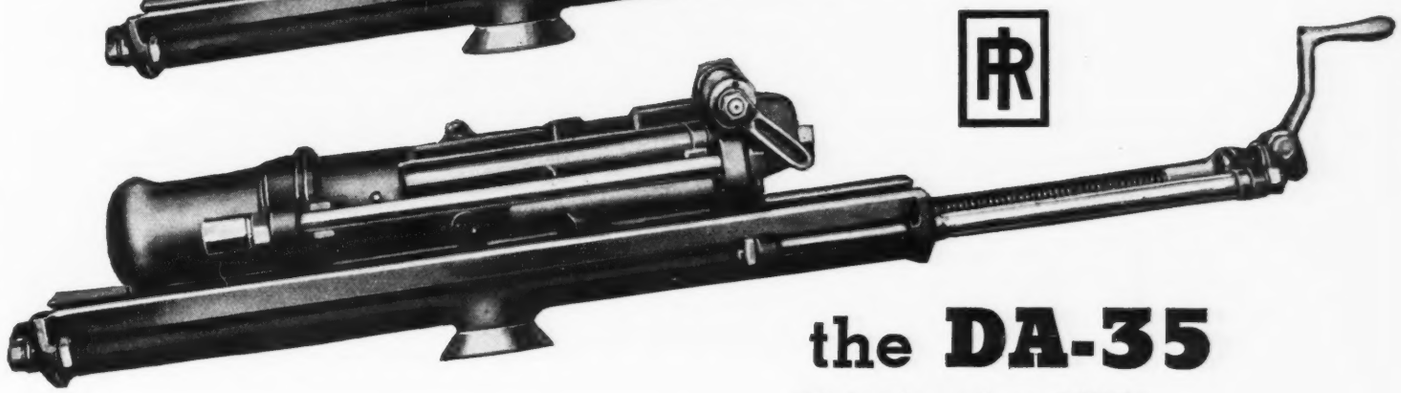

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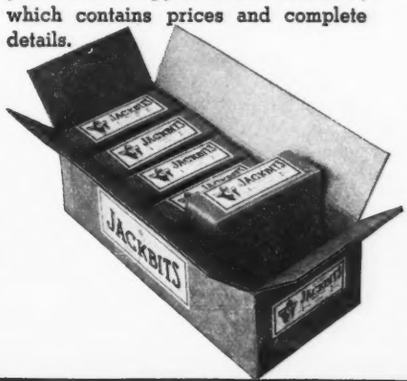

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NEWS FROM Washington

By Special Correspondent

AGENDA for the forthcoming session of Congress were presented by the President's fireside chat of mid-October, when he also reported on his Western travels. The list of important subjects requiring legislative study included only one new item, anti-trust legislation. And that item was not really new, except with respect to the importance and urgency ascribed to it by the President.

Quite as significant as the listing of wage-hour standards, agricultural control, Government reorganization, and regional planning, was the omission of new taxes. This omission from the President's list has not been understood by anyone to mean that a new tax law is not going to be high on the priority list of Congressional activity beginning Nov. 15.

The call for a special session of Congress was issued by the President despite strong political advice to the contrary. All observers agree that the President made this decision personally, and probably that it was based on his renewed enthusiasm as a result of the personal ovations experienced during Western travel. Washington believes that the President remains personally so popular as to be deceived regarding his strength of legislative leadership.

Tax Legislation

LEGISLATION will proceed, both during the special session and the regular session convening in January, from those points at which each proposed measure was laid aside in August. The special session has no significance as affecting the status of bills. It merely advances by six weeks the date on which Congress will take up its task.

Extensive hearings, probably in executive session on most topics, will precede public hearings or floor debate on those measures which most affect the cash drawer of the mining industry. Hearings on the tax bill were scheduled by Chairman Vinson of the House Ways and Means special subcommittee to antedate the opening of the session. But in the executive proceedings so planned, the primary effort is an exploration of possibilities and a reconnaissance of the mass of Treasury suggestions. When a tentative tax bill is presented to the full Ways and Means Committee, public hearings can be started.

The President mildly, and Congressmen enthusiastically, oppose new tax levies or increased tax rates where they can be avoided. But the announcement of Oct. 19 that the President now expects a deficit for the current fiscal year approximating $700,000,000 makes sure that some new or higher levies will be placed on business.

It will probably be well after the New Year before any intelligent forecast can be made as to the fate of any major item of tax revision. Present forecasts about changes in the undistributed earnings tax, capital gains taxes, or other specific measures are necessarily mere speculation. Even a knowledge of what the President personally will press in regard to these items would not be enough to determine the ultimate legislative fate in the tax bill, which probably cannot pass until March at the earliest. It still appears likely, however, that when the bill does pass any increases in levy on the income of individuals or corporations will be applied to the income of 1937. Only excessive delay in enactment of the bill seems likely to preclude that plan. The urgent need of the Treasury for more income makes every decision likely to be against the comfort of the taxpayer.

METAL PRICES

FURTHER DECLINE in goods prices, including metals, would be most unwelcome in Washington. On this theory, which seems well established in fact, economists in the Capital are freely prophesying no further influence of the New Deal which might result in lower prices for copper, lead, or zinc, as well as the precious metals. Washington continues its effort to distribute the load of gold in order that the cost of keeping so much idle in the Treasury reserve may be reduced. One of the recent arguments is that not only other governments and their central banks, but also the commercial banks of all industrial nations, should share in the burden of carrying gold reserves. This is one of the conditions which the United States Treasury will advance as it negotiates further under the Tri-Partite agreement with London and Paris. Washington does not expect any change in the Treasury's price for the purchase of silver, which still awaits an official announcement that probably will not come until near Christmas time. The present price for newly mined silver at 77c. plus continues through December.

FURTHER DESTERILIZATION of gold may be necessary in order to accomplish the various metal-stabilization and inflationary influences that are desired; but no change in the price of gold is expected. In fact, this desterilizing technic is perhaps the most potent available to the President and his fiscal advisors in the Treasury and the Federal Reserve Board for maintaining the oft-repeated objective of "stability." The President's reference in his speech of Oct. 20 to stabilization of "the real value of the dollar" is subject to many interpretations. It probably was not intended to imply that any commodity-dollar unit was under consideration or likely of adoption.

Budget Gloom

THE President's growing pessimism as to the actual budget results for the year ending June 30, 1938, was shown by the revised estimate of Oct. 19, officially forecasting a deficit of $695,000,000. But even this gloomy forecast is not bad enough to satisfy some of the Washington commentators. They argue that the Treasury will have to revise downward still further its estimate of income taxes expected next year. The recent stock market trends give credibility to this idea, for taxable capital gains reported next March are likely to be small.

Other critics of the budget statement claim that it is not reasonable to put in as a receipt any of the net income from the payment of Social Security taxes. This argument finds its major support in the theory that these taxes are never going to be enough to care for the moral commitments which the Government has made for old-age and other relief measures, as well as for the Federal share in unemployment burdens. Regarding these monies as a trust fund, rather than a current receipt, would be necessary to satisfy these critics.

Still other criticism relates to the item of net receipts from the settlement of PWA, RFC, and other similar loans or advances. These repayments are, of course, an aid to the Treasury in keeping the cash drawer properly supplied with funds. But the reclaiming of such advances does not really balance the budget, according to critics.

Summing up these various items gives a net budgetary deficit of as much as $1,500,000,000 the way some folks figure it. Obviously, there is no official acceptance of any such ideas. But all of this is important to business when figuring the real fiscal status of Uncle Sam's affairs, which in turn govern the business tax burdens in prospect.

War Problems

"PUTTING AN END to acts of international aggression" was rather an unexpected text from which the President preached his Chicago sermon on international morals. And apparently the President was shocked to find that this address of Oct. 5 was taken to represent an American commitment in international policy far more definite than was intended. The assurance of a "determination to pursue a policy of peace" was altogether overshadowed by the threatened "quarantine."

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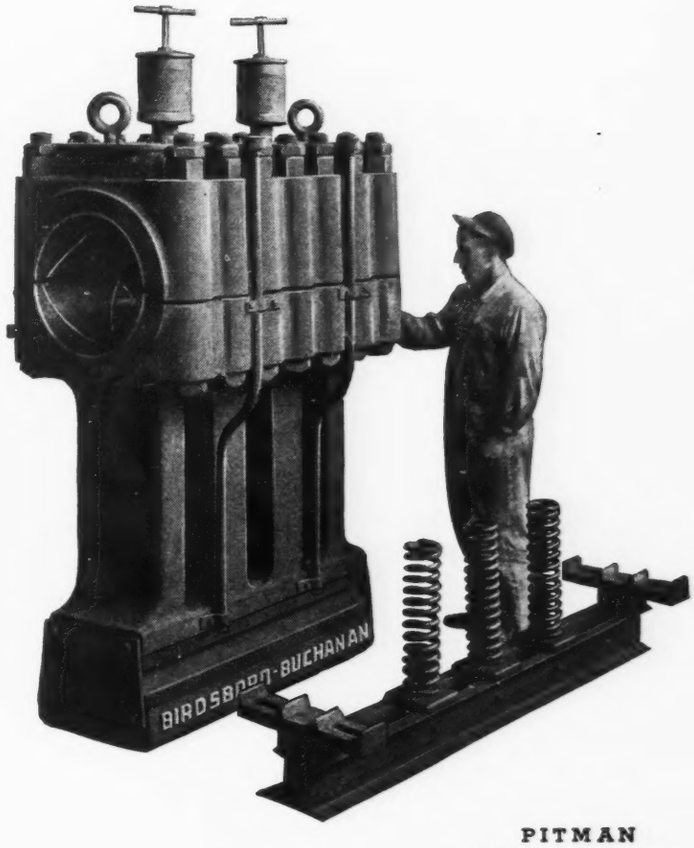

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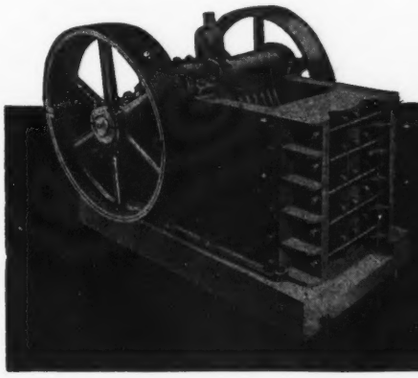
TYPE C. JAW CRUSHER



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enacted early in 1937, is not going to be undertaken by the President with respect to mineral commodities or anything else of importance in the Orient unless Congress compels a change in plan. But it is reported in Washington very frequently that the members of Congress are coming back to their legislative tasks convinced that the American people want peace, even at the expense of a pussy-footing policy. Such reports are said to explain the President's much less vigorous language of the fireside chat on Oct. 12. Washington generally believes that the President backed down from his Chicago stand deliberately in this second public statement of international policy. Some think that Congress will force a still further retreat toward traditional isolation.

Military authorities in Washington take these matters seriously. They are pressing as vigorously as possible the purchase of the strategic mineral reserves authorized by the last appropriation act for the Navy. Apparently most of the money then allocated for building up these supplies will be spent for manganese ore. Details of these deals of military significance are, of course, not announced officially.

The practical implications of trade embargoes, as imposed by Japan in order to conserve exchange, worry Washington much more from the political than from the economical point of view. If this market for cotton should be cut off while the present huge surplus hangs over the market, there would be consequences far more serious, so Washington thinks, than if some important mineral trade were interfered with. As a matter of fact, Washington thinks that Japan probably has now a sufficient stock of metals and minerals, so that further purchases of that kind will safely be deferred in order to conserve funds for more immediate fiscal needs of Nippon.

Production Controls

TWO MINERAL COMMODITIES are now the guinea pigs on which two groups are experimenting with different techniques for the control of production. The Federal effort to control coal for the benefit of coal miners is having a bad case of colic during its infancy. There is nothing yet to indicate that anyone is satisfied, not even the members of the Bituminous Coal Commission. The second effort is by interstate compact with Congressional approval as a means for petroleum production control. There, much to the disappointment of those who believe in federalization of all authority, considerable success appears to have been achieved.

Metal and industrial mineral groups are watching these two methods, because if and when either conspicuously succeeds there is likely to be imitation for the non-fuel minerals. Copper is a most likely next subject of vivisection or animal experimentation, or what have you? Those who hesitate to support official control argue in Washington for a counter plan. They suggest that the non-ferrous metals, copper for example, try a bit of self-regulation. And they argue rather persuasively that there is every reason to believe in the probable success of industry-managed regulation if the charge of monopoly could be eliminated. And here's the way they would eliminate that troublesome hurdle to self-discipline:

A good share of the copper-producing and copper-using industry of the country has climbed on the same price and marketing bandwagon, so they say. But the operator of this conveyance is driving blindly along the road of intelligent competition (that is what proponents like to call this highway), but without a first-class map. Washington thinks that the driver is in a dense fog of ignorance as to the facts. Some of official Washington thinks that only reliable, impartial production, stock, and consumption statistics will serve to eliminate the danger of driving the industry over a cliff into a real price collapse.

Those who propose further data point out that no one really knows just what 105 per cent of production capacity means. No one knows what are the present stocks of copper in the hands of processors and ultimate users. No one knows why these stocks are held. Some of them are for bona fide consumption. Some are for stabilization—a kind of commercial preparedness. Some are in governmental control (abroad, of course) as a part of military reserves. But also there are probably, or have been, large speculative stocks held by those nominally users. As evidence of this there is cited the well-known example of one big user who sold a large tonnage of its speculative copper stock in order to pay a dividend with the profits of 6c. copper sold in the 18c. market. Legal? Yes. Good for the industry? Decidedly no. Preventable? Yes, if complete publicity of stocks could be achieved.

That is the Washington story or argument. It has no Administration standing, but is being suggested there for consideration in the non-ferrous industry.

BIGNESS, THE "GOAT"

ANTI-TRUST legislation is being suggested to and by the President in many new forms. Robert H. Jackson, Assistant Attorney General, has gone farthest in this respect in the proposal that even the patent laws and the tariff levies be used for curbs on business bigness. Congress is not expected to go along with most of these more radical proposals. But some amendment and amplification of present laws would not be surprising. Rarely has Washington seen so bold a charge of near-deception made against any President as has followed the recent proposals about monopoly. Even the more conservative newspapers of the Capital City and the more friendly correspondents call these criticisms of business practice by the President a "smokescreen" or a "diversion." The charge is that the President wants to take the mind of the people off of Wall Street and the recession of business which the stock market decline is assumed to forecast or reflect.

WHETHER the President was intending this new effort in control of monopolies to be a distraction and a smokescreen, or not, there is no doubt as to the seriousness and sincerity of desire of the reform element in the present Administration to achieve the objectives referred to. Bigness remains badness in the minds of New Dealers, including particularly the New-Dealer-in-Chief. This is a fact which mining industry will undoubtedly find more of concern than many other divisions of business, because of the intrinsic advantage of integrated enterprises, which means bigness in the mine and mineral fields.

Federal Incorporation

IT IS EXPECTED that Senator O'Mahoney will press further this winter his bill for Federal incorporation of enterprises doing interstate business. Some of the arguments used by this Western Senator are going to come from the mining industry. The analogy with the persuasive public-utility holding-company arguments is clear, but often overlooked. A mining enterprise with its mines and smelters in California often for taxation or other reasons incorporates in Delaware. It then establishes business activities in other states. Thus it sets itself up, according to the critics, as beyond the reach of any reasonable regulatory agency. Uniform state legislation regarding business enterprises is as difficult to secure as a uniform divorce law, and for the same reason. Each state is seeking its separate advantage. Thus the Wyoming Senator and many others reach the conclusion that Federal charters for interstate enterprises are essential.

Some long-visioned critics of this philosophy suggest that there may be a silver lining behind this Federal incorporation cloud. Here is their argument, interesting but none too persuasive: If industries of this sort were subject to Federal control a new system of taxation might be developed. It might be possible to place a separation tax or production tax on these enterprises, in lieu of those real-property or resource taxes now imposed. The theory of this changed system of levies would be that conservation of mineral resource would be economically safe and feasible if the ore reserve was not eating off its head in the tax barn.

These are but two of the major arguments now in the making. They illustrate only the long-range complexity of the question that will be argued fluently during the coming special and regular sessions of Congress.

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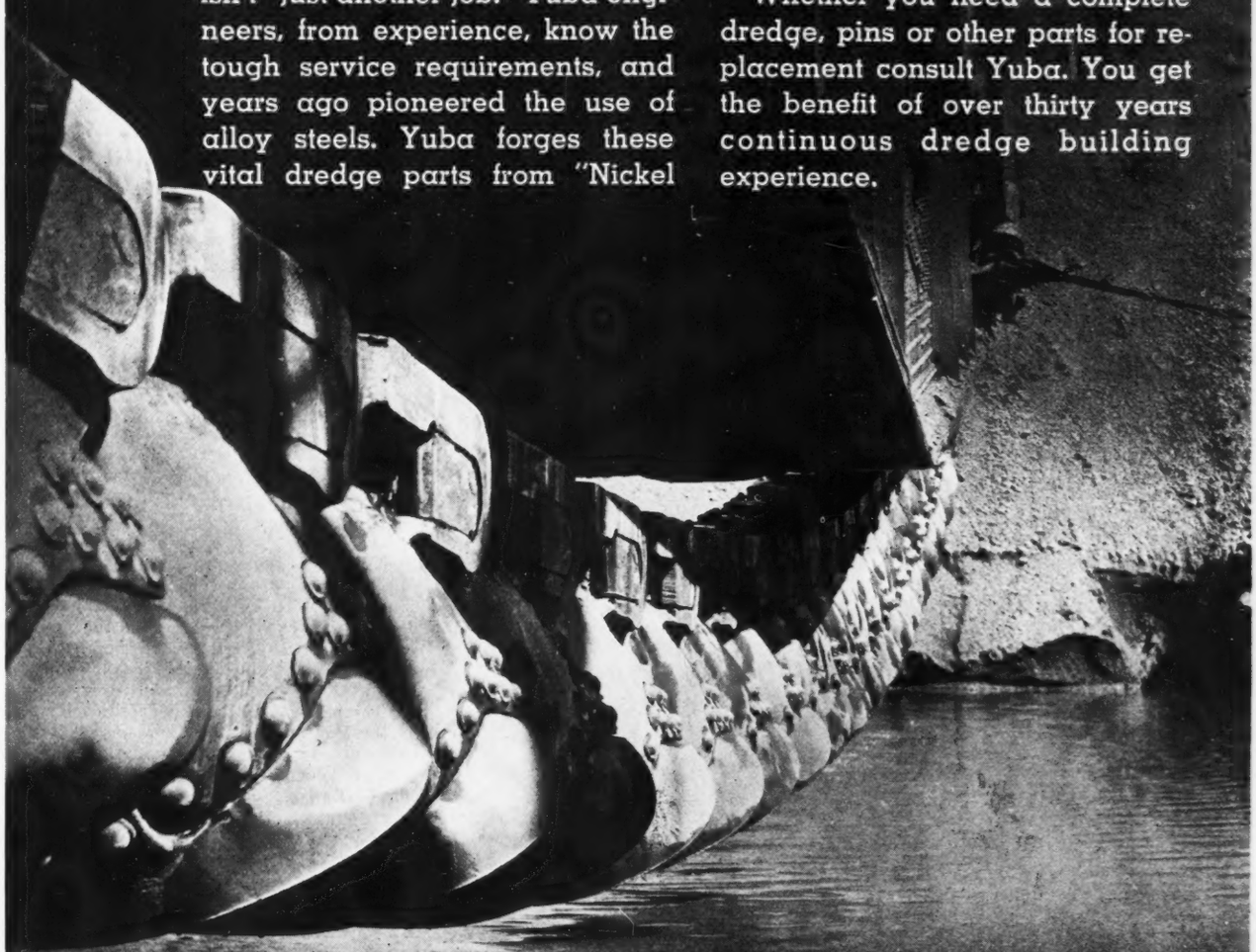

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Bureau of Mines Dedicates Eastern Experiment Station

Building at College Park, Maryland, to house research activities of Mon-metals, Metallurgical, and Mining divisions of the organization

WITH APPROPRIATE CEREMONIES and the participation of the University of Maryland, the American Mining Congress, and the American Institute of Mining and Metallurgical Engineers, Dr. John Wellington Finch, Director of the United States Bureau of Mines, publicly dedicated the Eastern Experiment Station on Oct. 15. The structure, illustrated herewith, was built as a PWA project on a tract of twenty acres donated by the University of Maryland, adjoining the campus. Inasmuch as the station will be devoted principally to the study of non-metallic, or industrial, minerals, the dedication was appropriately preceded on Oct. 14 by a one-day meeting of the Industrial Minerals Division, A.I.M.E., in Washington, D. C.

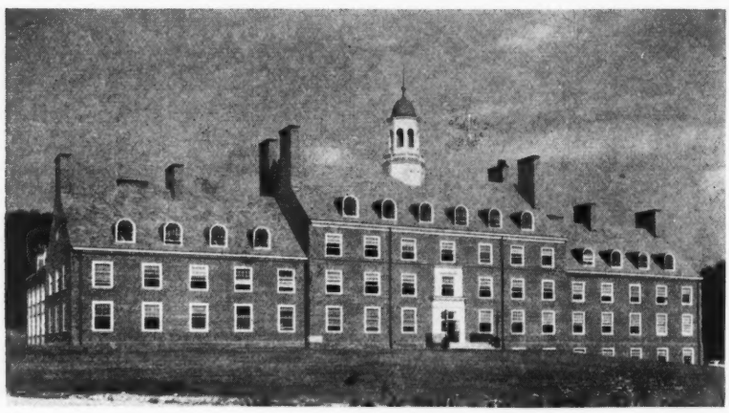
The growing importance of industrial minerals, which occur most abundantly in the Eastern part of the United States, and the urgent need for better facilities to study the problems of industrial mineral producers, were the primary reasons for establishing the new experiment station at its present location. Hitherto the Bureau has been handicapped in this phase of its work by the lack of a suitable building and equipment.

Presiding at the exercises, Julian D. Conover, secretary of the American Mining Congress, called attention to the importance of the mineral industries in the nation's economy, and cited the excellent work of the Bureau of Mines in promoting the technology, economics, and safety of mining, in spite of pitifully inadequate funds appropriated for the work. "Approximately twenty-five million of our people," said Mr. Conover, "are directly or indirectly dependent upon the mineral industry for their livelihood. The total investment is nearly $15,000,000,000 and the average annual value of mineral products is approximately $4,500,000,000. Some idea of the magnitude of mineral production can be had when we realize that over 50 per cent of the tonnage handled by our railroads is made up of the products of mines and oil wells."

A message from Harold L. Ickes, Secretary of the Interior, was read by Mr. Conover. In this the Secretary emphasized the need of a national policy of conservation, which, he said, "has become a paramount issue in the present administration." He referred to the early liberality of the Government in land use in order to encourage settlement by pioneers. "This extravagant spirit," he said, "built up the rich regions west of the Alleghenies, but it entailed a reckless use of land and resources which has not entirely ceased." By inference he advocated national control of "public lands and mineral and water resources" in a Department of Conservation in which "conservation would become the central driving force of the organization."

Touching on the work of the Nonmetals Division in the new Eastern Experiment Station, Dr. Finch found its principal field of study in the improvement and utilization of such nonmetallic minerals as lime, clay, kaolin, feldspar, fluorspar, kyanite, talc, and mica. The Eastern States, served particularly by this station, have important deposits of these minerals, and our work has shown that it is feasible to improve them by suitable treatment so that they can replace imported minerals. In his closing remarks he dedicated the new station "to be the home of research designed to increase efficiency in our mineral industries . . . and a source of knowledge that shall be shared with all the world."

Bureau of Mines staff members having headquarters at the Eastern Experiment Station will comprise: Oliver C. Ralston, chief engineer, Non-metals Division; V. H. Gottschalk and C. W. Davis, Metallurgical Division; J. R. Thoenen and McHenry Mosier, Mining Division; Frank L. Hess, principal mineralogist.



The station is designed and equipped for work on the non-metals, metallurgical, and mining divisions of the Technologic Branch of the Bureau of Mines. It will be used for conducting scientific and technologic investigations concerning mining and the preparation of mineral substances with a view to the increase of health, safety, and efficiency in the mineral industries, and to conserve resources through the prevention of waste

Utah

Frisco District Gains Prominence

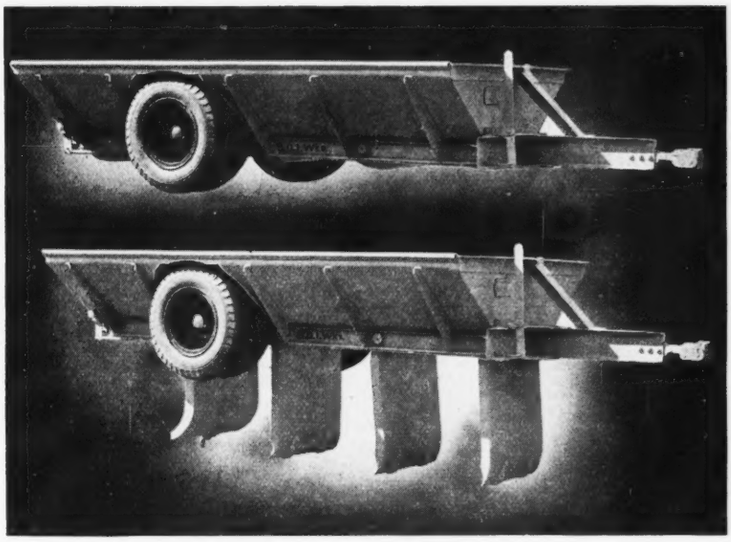
Production soon under way from several deposits developed in the Buckskin Limestone—Work at Elton tunnel proceeds after brief shutdown

▶ Ore discoveries in the Horn Silver and the adjoining Frisco Lulu property have revived interest in the Frisco district, near Milford. The McGarry brothers employ a crew of about 30 men developing ore running from $24 to $200 a ton in lead, silver, gold, and zinc on the surface. On the west slope of the Grampian Mountain, in blocks of ground adjoining the well-known Horn Silver ore body, it is reported, thirteen veins have been opened in the Buckskin limestone, from which regular shipments of ore will be made to the smelter as soon as a road is completed. Subsequent to the discovery of the mineralization, the McGarry brothers took leases on claims belonging to the King David, the Tintic Lead, and Horn Silver companies, and also secured control of the Bonanza Mining Company. This company owns the Frisco Lulu property, in which a shaft 900 ft. had been sunk. Two tunnels are being advanced to open at depth ore showings exposed on the surface. McGarry brothers announce that the Frisco Lulu shaft will be rehabilitated and drifting started on the 200 and 400 levels.

▶ Two streaks of high-grade ore have been opened in the Chief Consolidated Mining Company's Apex Standard mine, near Eureka, on the 1,000 ft. level about 250 ft. northeast of the shaft. A 6-in. streak carries high-grade gold and silver ore and a 12-in. streak high-grade silver. The ore lies in the hanging wall of a fissure paralleling the Eureka Standard fault.

▶ Stockholders of four companies controlled by the Tintic Standard Mining Company will vote Nov. 15 on the plan to consolidate the contiguous properties in one estate, held by a new company—the Eureka Lilly Consolidated

The S-D Under-Ground-Hog



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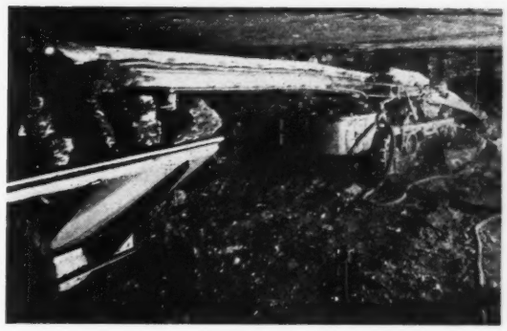

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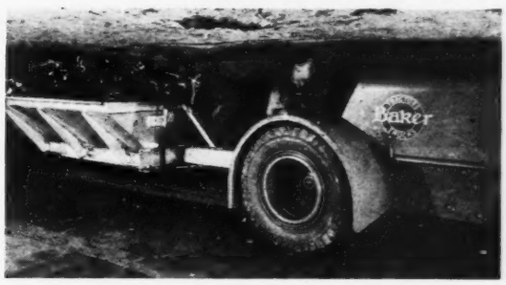
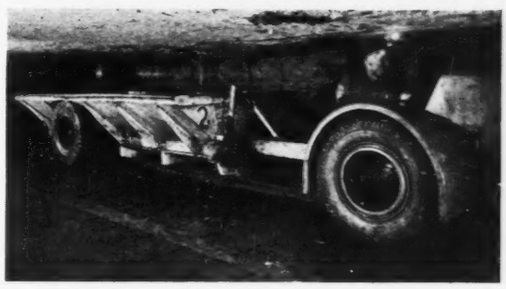


At Pit—about to dump automatically.



Dumped—automatically and instantaneously—never out and never over, always moving on.

▶UTAH

Mining Company. The companies for which the merger is discussed are the Eureka Lilly, the East Tintic Consolidated, the Provo Mining, and the Iron King Consolidated Mining Company. The consolidated company will have a capitalization of $350,000 divided into 3,500,000 equal shares, of which 3,259,003 will be exchanged for the stock of the merged companies.

▶New Quincy mine leasers at Park City shipped the fourth carload from the 900 level, which netted $2,130.44 a ton. The four carloads have brought a net smelter return of $7,764.15. The leasers report that although the vein is narrowing slightly from its width of 5 ft. where first struck, the metal content is improving.

▶Operations of the National Tunnel & Mines Company were suspended at Bingham and Tooele on Oct. 22, during the absence of general manager J. O. Elton of the International Smelting Company, while making a brief trip to New York City. Work resumed during the week of Nov. 1. The tunnel has advanced about 4,500 ft. of its total projected length of 23,000 ft.

Montana

Lower Copper Prices Bring Wage Drop

Lack of demand for copper forces curtailment in production at some mines

▶To offset the increasing stocks of copper, the Anaconda Copper Mining Company has found it necessary to close its Badger State Mine, at Butte, together with dropping its reconditioning program pointing to the reopening of its Mountain View mine. The Tramway mine was closed Oct. 28, affecting about 900 men. Falling metal prices lowered wage scales 25c. in Butte when copper sold under 13c. for more than 30 days. This conforms to the agreements existing between the company and the labor unions affected, and the minimum wage is now $5.50. This cut affects approximately 12,000 men.

▶A newly organized corporation, the Yellowstone Gold Mines, Inc., has acquired a large acreage in the Cooke area under the management of A. Franchie, of Great Falls. Other officers include Bruns Heinrich, of Chicago, president, and John Lutz, also of Chicago, secretary-treasurer. There has been no announcement of immediate plans beyond the reconditioning of equipment installed on the various properties during periods of earlier operation.

▶Humphreys Gold Corporation is employing about 60 men in its Clancy Creek dragline placer operations near Helena. Total yardage handled daily approaches 9,000, of which about two-thirds is discarded overburden and 3,000 yd. is washed. The operation is under the supervision of D. G. Brown.

▶It is reported that L. H. Brooks, of Sheridan, Wyo., who has been active in reopening mining property in the Cooke City district, has been instrumental in organizing a company to take over the operation of a group of gold-silver properties in the Gilt Edge district near Lewistown, Fergus County. It is probable that first activity will be toward reworking extensive tailings discarded in former operations.

▶A new road has just been completed to the Butte-Highlands mine, south of Butte, which it is believed will permit continuous travel throughout the winter. The 50-ton cyanide plant at the property has been fully conditioned and is expected to begin operations by re-treating tailings from an earlier flotation plant. A sufficient quantity of this material is reported to permit the extensive underground development to continue without diverting attention to underground mining for several months. Robert J. Woody is mill superintendent under W. L. Bell, of Butte and Spokane, who is in charge of operations.

▶According to reports, a 40-ton car of high-grade gold ore was shipped from the Little Ben Mine, at Landusky, which returned $43,600. The ore is said to have been taken from a newly discovered pay streak. High-grade shipping ore is not unusual from the Little Rocky district, but comes as a surprise from the Little Ben, which has been a continuous milling operation since 1931.

▶The Easton Pacific Mine, near Virginia City, is making steady shipments to the Anaconda smelter of ore produced from the Main and Center veins. No. 1 shaft on the Center vein now down 75 ft. The property is operated under lease by the Alabama Montana Gold Mining Company, Harry Reynolds, president.

Idaho

Old Mines Reopen and Add to Metal Output

Terrible Edith and Anchor mines plan production — Placer districts report good summer

▶Terrible Edith Mine, in the Murray district, is to again enter production after a shutdown for a number of years. During its history of some 30 years the mine has shipped large amounts of lead-zinc-silver ores. The mine recently passed into the ownership of the Midland Mining Company, with offices in Midland, Mich. Plans for the sinking of a main working shaft are now well advanced, according to H. C. Stapleton, of Murray, vice-president and manager. H. C. Eastman, of Midland, Mich., is president of the company.

▶Anchor Mine, in the Murray district of the Coeur d'Alenes, started production early in November, according to John George, manager. A raise, 230 ft. in length, has just been completed, connecting the No. 1 and No. 2 tunnel levels. Ore in places 8 ft. wide has been developed and stopes are now being started on the No. 1 and intermediate shaft levels. Principal values are in lead and silver. Crude-ore shipments will be made to the Bunker Hill smelter, at Kellogg. John George is manager.

▶The National Labor Board's 29-day inquiry into the CIO strike at the Sunshine mine last August has been completed and a transcript of the testimony forwarded to a special three-man board in Washington for a decision. The charge of intimidation and coercion, brought by the CIO, was vigorously denied by the Sunshine officials. During the hearing 225 witnesses were on the stand.

▶Shaft work at the Liberal King mine, on Pine Creek, near Kellogg, is well under way. The first shaft sets have been placed and a hoist will be installed soon.

▶Sunshine Mining Company produced 2,813,132 oz. of silver for the quarter ending Sept. 30, according to a statement issued by R. D. Leisk, general manager. Net smelter returns for the period were $2,115,359. For the three quarters of the year dividends have totalled $3,349,847. The report shows the number of tons milled as 52,610, in which the average silver assay content of the heads was 53.3 oz. and the average tailing content, 0.67 oz. Percentage of extraction was 99.8 and the ratio of concentration was 20 to 1. The mill handled an average of 583 tons daily and produced 29 tons of concentrates each day.

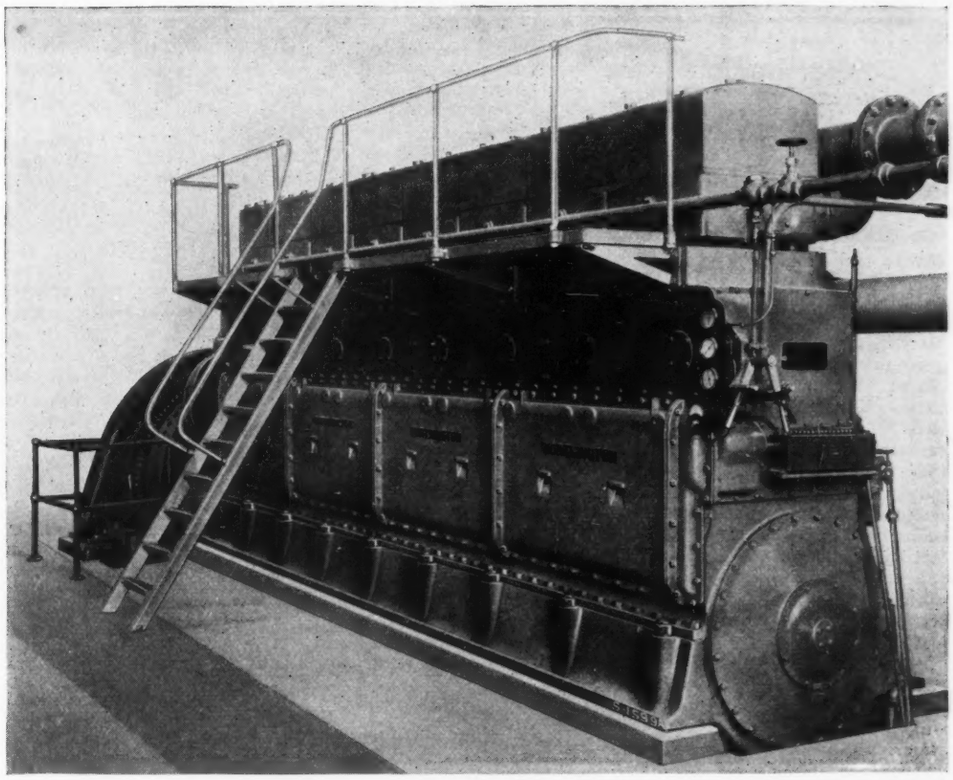
▶Atlas Mining Company, south of Mullan, will soon resume operations, according to W. Earl Greenough, of Mullan, president and manager. The proposed work will be a continuation of the west drift a distance of approximately 1,000 ft. to prospect an area with a favorable ore showing in upper levels.

▶Callahan Zinc-Lead Company has stepped up the capacity of its Galena mill to treat 150 tons of ore daily, according to Joe Hall, of Wallace, secretary of the company. Former capacity was 110 tons daily. The mill is treating ore from the Interstate mine, in the Nine Mile district.

▶Sunshine Consolidated, in the Big Creek district, has development operations proceeding on an enlarged basis following settlement of court actions involving ground embraced in the Coeur d'Alene-Big Creek holdings which has now passed to control of the Consolidated. Development work is being carried on from the 1,700-ft. level of the Sunshine shaft and is being done under contract by the Sunshine Mining Company.

▶The American Mining & Developing Company, at Salt Lake, has purchased the holdings of E. R. Bellows in the Elk City district of central Idaho and is making arrangements for a development program.

WORTHINGTON DIESEL ENGINE POWER



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Michigan

Copper Region to Be Mapped by Aerial Survey

Four counties will be studied from mosaic maps—New process of making copper fittings developed at Michigan College of Mining and Technology

▶ Preliminaries for the long-planned aerial survey of the Michigan copper district, as one of the steps to facilitate geological exploration, have been completed with the awarding of a contract to the Kaufman Aero Service Corporation of Philadelphia. The Philadelphia company will photograph from an altitude of 20,000 ft. and cover approximately 3,200 square miles of Keweenaw, Houghton, Ontonagon, and Baraga counties. For this work the contract price is $4.20 a square mile. The survey, made possible by an act of the 1937 State Legislature, is a cooperative project involving the United States Geological Survey and the geology division of the Michigan Conservation Department. An appropriation of $25,000 was passed by the Legislature, which will be matched by the Federal Government. Photographic mosaic maps will be prepared from the photos made by airplane. From these mosaics, base maps will be prepared which will be useful for exploration for copper. "We know there must be more ore in these counties than in the proven area," said R. A. Smith, state geologist. "The aerial mapping and a subsequent magnetic survey will establish this. Development has been handicapped by poor mapping."

▶ Applying the principle that copper will flow cold under pressure, the Michigan College of Mining and Technology, at Houghton, has developed a process of making copper fittings which is relatively inexpensive and which, it is believed, will go a long way toward increasing the use of copper tubing for various purposes. The process was developed by the mechanical engineering department, of which Prof. R. R. Seeber is the head. It has been protected by patents in the United States, England, France, and Germany, and the college has entered into contracts with two manufacturers in the United States and one in England for the use of the process in manufacturing copper fittings. The college will receive the royalties, which will be used for research extension. The names of the firms with which the college has made contracts are the Wolverine Tube Company, of Detroit, and the Northern Indiana Brass Company, both in this country, and Imperial Chemical Industries, Inc., of London, England. According to Professor Seeber, perfect copper fittings can be produced at half the cost of either casting or welding. The fittings also are easily and cheaply made. They have been made in sizes from one-half to two inches, which will meet the requirements of most building needs. The process by which the fittings are made is to take a piece of copper tubing, fill the center with an alloy of lead, bismuth, tin, and cadmium, which melts at a low temperature and does not affect the copper, place the tubing in a die and apply heavy pressure at both ends of the tubing. Under pressure the cold copper and the alloy filling flows into the unfilled portions of the die, creating the desired fitting. Very little machine work is necessary after the fitting is taken from the die. The alloy filling is easily melted out.

Iron Country

Operations at Some Mines Curtailed

Lack of ore demand forces suspension of several plans for winter work——61,000,000 tons estimated shipped this year

▶ M. A. Hanna & Company has refused to accept a labor contract drawn up by the C.I.O. A circular letter was sent to all employees stating the various reasons for not accepting the contract. So far the only contracts now in force are the ones in effect by Butler Bros. and the Wisconsin Steel Company. Disquieting news the last few weeks has cut down the schedules of several mining companies and practically all operating companies are retrenching, and this also will retard the winter work as originally planned. It is believed by most operators that conditions will be quiet on the range for the next few months.

▶ The ore movement in the Lake Superior District now appears to the expert guessers at about 61,000,000 tons.

▶ Construction of large towers for the dragline scrapers is under way at the Spruce mine, at Eveleth, Minn.

▶ The Wacootah mine of the Wheeling Steel Corporation is nearly ready to end shipments for the season. About 425,000 tons were shipped during the year.

▶ The Canisteo mine and Hill-Trumbull mine washing plants have been closed for the season. At the Hill-Trumbull mine ore is being shipped from the concentrate stockpile to be transported by late boats. Shipments from the Canisteo mine will total 600,000 tons and from the Hill-Trumbull 800,000 tons. Both the Hill-Trumbull and Canisteo mines are now following out a stripping program.

▶ A group of range men have organized the Fin Mining Company to develop an iron property a short distance north of Virginia, Minn. They plan to ship ore to the Sliver mine washing plant.

▶ Evergreen Mines Company has changed the name of the old Fayal No. 1. mine to "Alice." This mine is located in Eveleth, Minn.

▶ Butler Bros. are planning to strip the Galbraith mine, near Cooley, Minn. This operation will use power shovels, tractors, trucks, and wagons.

ACCREDITED CURRICULA IN METALLURGICAL AND MINING ENGINEERING

Below are listed the educational institutions in the United States whose courses of study in mining and metallurgy have been accredited by the Engineers' Council for Professional Development as of Oct. 1, 1937. Comment will be found in the editorial pages of this issue. The list does not include several schools that have applied for accrediting with the request that inspection be made in 1937-38.

Requests for further information regarding E.C.P.D. and the accrediting program may be addressed to A. B. Parsons, Secretary, Engineers' Council for Professional Development, 29 West 39th St., New York, N. Y.

Metallurgical Engineering

University of California (metallurgy)
Carnegie Institute of Technology (a)
Case School of Applied Science
Colorado School of Mines
Columbia University (b)
Harvard University (physical metallurgy) (c)
University of Illinois
University of Kentucky
Lafayette College
Lehigh University
Massachusetts Institute of Technology (metallurgy)
University of Michigan
Michigan College of Mining and Technology
University of Minnesota
Missouri School of Mines and Metallurgy
Montana School of Mines
Ohio State University
University of Pittsburgh
South Dakota State School of Mines
Stanford University
University of Utah
University of Washington
State College of Washington
University of Wisconsin
Yale University

Mining Engineering

University of Alabama
University of Arizona
University of California
Colorado School of Mines (mining engineering)
Colorado School of Mines (geological engineering)
Columbia University (b)
University of Illinois
University of Kansas
University of Kentucky
Lafayette College
Lehigh University
Massachusetts Institute of Technology
Michigan College of Mining and Technology
University of Minnesota (excluding mining geology option)
Missouri School of Mines and Metallurgy (Mining Engineering) (excluding mining geology option)
Montana School of Mines (mining engineering)
Montana School of Mines (geological engineering)
University of Nevada
University of North Dakota
Ohio State University (mine engineering)
University of Pittsburgh
South Dakota State School of Mines
Stanford University
University of Utah
University of Washington
State College of Washington (excluding mine administration and petroleum engineering options)
West Virginia University
University of Wisconsin

(a) Accrediting applies to both the day and evening curricula. (b) Accrediting applies to the four-year and five-year curricula leading to the bachelor of science degree. (c) Accrediting applies only to curriculum as submitted to E.C.P.D. and upon completion of which a certificate is issued by Harvard University certifying that the student has pursued such a curriculum.

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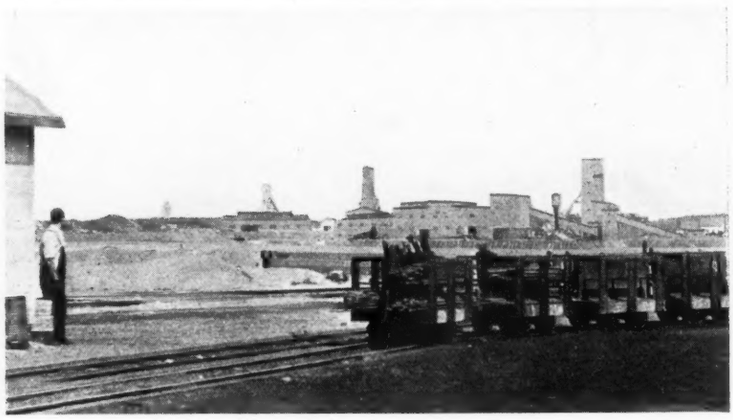

Looking east along the strike of Kirkland Lake's "main break." Cars in the foreground loaded with drill steel are at the Lake Shore mine. Wright-Hargreaves mill and shaft houses in background

Canada

Underground Mill at Big Missouri Takes Form

New power plant recently started will supply energy for all operations—Copper concentrates shipped to Japan

▶ Machinery for a 750-ton mill is now being installed in the huge underground chamber excavated at the Big Missouri, in the Portland Canal district. Recently the 2,300-hp. hydro-electric plant was completed. Consolidated M. & S. engineers designed the plant with the object of taking care of present and future requirements. Air compressors, mine haulage system, and mine and mill operations will be operated by electrical energy from the new station, and, in addition, ample reserve power has been developed for electric ranges in the big boarding house and for domestic ranges in the homes. It is also intended to heat all outside buildings at the property and the underground mill with electric heaters.

▶ The development of orebodies of extremely high grade in the narrow veins of the Zeballos area, on the west coast of Vancouver Island, is continuing. It is reliably reported that ore having a value of about $80,000 was taken from a tunnel driven 200 ft. in one vein at the Privateer mine. A second tunnel at a further depth of 75 ft. has opened about 100 ft. of ore of similar grade to date. The mine is owned by Nootka Zeballos Gold Mines Ltd., of which D. S. Tait, of Victoria, is president. At the Goldfield group of Spud Creek Gold Mines Ltd., 2½ miles distant, orebodies of fairly large size have been opened at three levels. One oreshoot has been opened for a length of 380 ft. to date, and both drift faces are still in high-grade ore. The area has been staked solidly for a distance of about 15 miles and across a width of 3 miles. Numerous properties are being bonded, and it is expected new and important discoveries will be made soon.

▶ The restriction of antimony and mercury output in war-torn China and Spain, and the consequent increase in the price of these metals, have greatly stimulated the development of cinnabar and antimony properties in the Bridge River district. At the Manitou Mining Company's property, ore carrying 17 lb. of mercury to the ton has been opened across a width of from 3 to 5 ft. in three tunnels and an open cut. The intervening distance is 500 ft., and it appears that commercial ore will be developed for this length, and possibly also further to the west. R. H. Stewart is managing director. At the property of Conardon Mercury Mines, near by, encouraging results have also been obtained. Native quicksilver has been found in considerable quantity at both properties.

▶ Plans have been made for mining antimony ore at the Reliance and Congress mines and treating their production in the adjacent Wayside mill. American interests have formed the Bealemore Milling Company, Ltd., to finance the mining companies' operations and concentrate and market the ores. T. C. Botterill, engineer in charge at the Congress, estimates that mill heads can be maintained at 2 per cent antimony and 0.2 oz. gold per ton, of a gross value of approximately $14 per ton.

▶ Further expenditure of $150,000 to develop the Minto mine at greater depth is recommended by the company's consultant, A. G. Larson. Work at the 700 level has failed to disclose ore of commercial grade, but the occurrence of stringers of high-grade ore encourages the belief that values will improve at greater depth.

▶ It is announced that a 50-ton mill is to be built as soon as possible at the Cariboo-Hudson, thus bringing into production the first successful lode mine in the southern part of the Cariboo gold belt. The property was discovered and developed by Fred M. Wells, the locator of the Cariboo Gold Quartz mine.

▶ The new 7,500-kw. power plant of Granby Consolidated at Princeton is now in full operation, and the production from the Copper Mountain mine is being increased to the mill's capacity of 3,000 tons a day. A shipment of 5,000 tons of concentrate went forward to Japan recently.

▶ Operations are being continued at several lead-zinc properties in the Slocan district, although the fall in metal prices has eliminated the profit margin of most of them. At the Lucky Jim, of 300 ft. of drifting completed by the end of September, 118 ft. was in ore. Milling was suspended some time ago, but 114 tons of accumulated concentrate was shipped to the smelter in September. A trial shipment of three carloads of concentrate went forward recently to Japan from the Whitewater mine, according to W. H. Burgess, managing director.

▶ A new producer in the Red Lake district of northwestern Ontario, Gold Eagle Mines started operation of a cyanide mill of 125 tons' capacity on Oct. 11. A winze is to be put down soon from the 500-ft. level for depth exploration on the No. 1 shear zone. One year's mill feed is provided by ore reserves blocked out on the upper levels, where a system of underhand open stoping has been adapted. Mill heads are expected to average around $12 per ton after low-grade material has been used for the tuning-in period. Walter F. Stafford, president, and R. W. Brigstocke, consulting engineer, were on hand for the opening of the mill.

▶ Wright-Hargreaves Mines, operating a 1,200-ton mill in the Kirkland Lake camp, shows more favorable results for the last fiscal year than for any other period in the company's sixteen-year history. During the past year a mill increase of 100 tons daily has made it profitable to treat a lower-grade ore. Reserves have been substantially increased, although depth development has not yet extended below the 4,500-ft. horizon. Clean-up work has been advancing for the last five years on the upper levels, with the result that larger tonnages are now in sight than ever before in several of the shallow sections. New levels established below 4,000 ft. have opened up ore grading higher than mine average. As part of the recently adopted expansion policy, Wright-Hargreaves has taken over the Murphy property, in Hearst Township, Larder Lake district.

▶ Pamour Porcupine Mines promises to take its place around the end of the year as the ninth largest gold producer in Canada, reflecting mill increases to 1,400 to 1,500 tons a day. Monthly output is now approximately $200,000, a year and a half after the mine started production. J. Y. Murdock is president of this Noranda-controlled opera-

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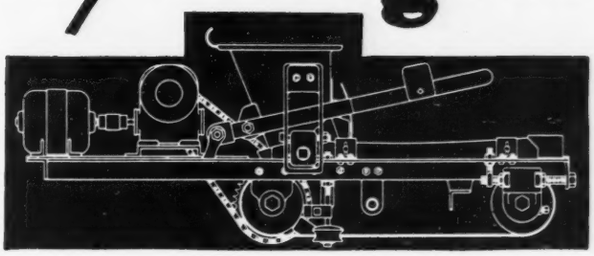

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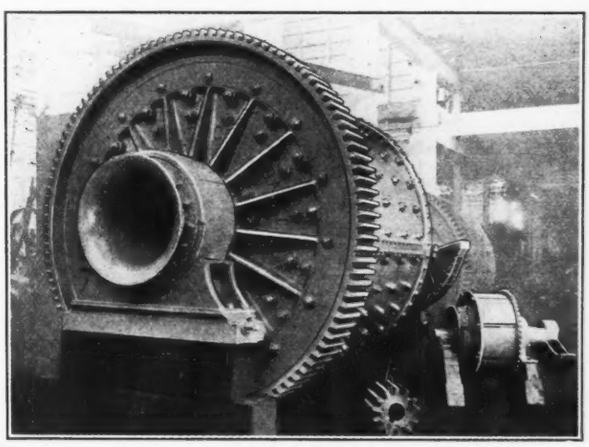

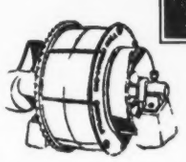

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tion, which is now engaged in extensive exploration to determine depth possibilities of the large orebodies.

▶ A fine record of operating efficiency is being shown by Sturgeon River Gold Mines, where the daily milling rate was increased in October from 70 to 85 tons, after sorting out approximately half of the ore broken. Sorting is carried out underground and again in the crushing plant. In the first five months of operation, to the end of August, the value of gold recovery has amounted to $146,915. Operating profits are about $50,000 according to official reports. Mill heads have been steadily raised, averaging $19.60 in August, compared with $12.60 during the preceding month, which is a remarkable grade in relation to the stoping problem involved in breaking down ore across an actual vein width of only 10 in. Mining widths are calculated at 30 in. Both the vein material and the distribution of gold values are erratic. On the 500-ft. level a new ore section has been opened up lately for a length of 175 ft., grading $14 across the calculated 30-in. width.

▶ Leitch Gold Mines, near Beardmare, Ontario, and 20 miles east of the Sturgeon River mine, has recently announced that enlarged ore reserves will soon lead to stepping up milling above the present rate of 65 tons per day.

Mexico

Threats of Labor Strife Continue

Mexican mining industry awaiting decision by Federal Board of Conciliation on wage increase demands by oil workers—Employees fail to make profit after running Don Carlos Mines

▶ Fall finds the Mexican mining industry confronted with perhaps the most interesting phase of its history, a problem in which labor figures prominently and has several national economic ramifications. Delay of the Federal Board of Conciliation and Arbitration in rendering a decision in the oil controversy is attributed to complications that have arisen in petroleum matters which are closely related not only to government and private economics but to the mining industry. The ruling in the oil question which was expected for early October is not now looked for until some time in November and perhaps even later. It is evident that the board is giving the oil case extraordinarily careful attention and does not care to render a hasty verdict. Oil and mining contribute about 60 per cent of the Mexican Government's revenues. There are fears that if the oil workers get their demands, featuring greatly exalted wages and expensive economic benefits which the oil companies have flatly told the Government they cannot afford to meet, miners will start similar action. Indeed, a large element of miners have already begun such a movement, the controversy with American Smelting for a single contract, involving a great boost in the company's overhead for all its Mexican units. Advantages for miners similar to those that the oil workers are demanding are seen as most unfortunate for the industry, a considerable part of the productive phase of which, unlike the oil sphere, is in the hands of small-scale operators, most of them Mexicans, who would be driven out of business if greatly increased wages and drastic conditions are decreed for them. Though the Federal treasury is enjoying record revenues this year, it is experiencing enormous, even unprecedented, expenses for such public works as railroads, highway and irrigation construction, and education. The possible chance of the United States changing its silver-buying policy also injects uncertainty in the Government's plans. Therefore, the board's task is far from easy. Mining and the Government's economic position are seen as having a big bearing on the case.

▶ A strike was averted for Cia. Minera Las Esperanzas, working at Las Esperanzas, Coahuila, by action of the Federal Labor Department, which resulted in making a new collective work contract that allows higher wages and some other privileges.

▶ Guanajuato Reduction and Mines (Guanajuato, State of Guanajuato) made peace with its workers by agreeing to grant increased pay which entails a monthly payroll boost of 4,000 pesos (about $1,150) and to pay the miners' union 2,000 pesos when it lifts the embargo placed Aug. 6 on some of the company's ores in connection with a work disagreement.

▶ Federal financing in the form of loans from the new National Industry and Workers Bank, organized to help along small industries and workers who take over businesses to run on a cooperative basis, is assured employees of the Dos Carlos mines, Pachuca, Hidalgo, which took over the property from its British owners last June to run as an experiment for six months. The first Federal loan for these miners is to be 20,000 pesos (some $5,600). There are now 1,500 men working the Dos Carlos property. They soon ascertained that the company was right when it contended that the mines, which have been worked since the '70s, are exhausted. The cooperative has been carried along by funds provided by the national miners' union, individual miners, and, to a certain extent, by money help from the Federal and Hidalgo governments. The Federal labor authorities deny reports that these mines have been expropriated and assert that such action is not contemplated for them. The miners have asked permission of the Federal Government to exploit that part of a reportedly rich vein discovered on the adjoining property of Cia. Minera de Real del Monte y Pachuca which runs into the Dos Carlos holdings.

▶ Cia. Minera Dos Estrellas, operating at El Oro, State of Mexico, and Tlalpujahua, Michoacan, was denied permission by the Federal Board of Conciliation and Arbitration to reduce wages. The board asserted that though the company has suffered losses, its profits are still considerable and it can well afford to pay the higher wages provided in a collective labor contract made last February.

▶ Payment of full wages during the time the companies suspended operations has been ordered Promontorio, operating near Durango City, Durango, and Piedra Bola Mining, whose properties are at Piedra Bola, Jalisco. The companies asked the Federal labor authorities for permission to quit work on the ground that it is unprofitable. When the authorization was refused, the firms ceased operations.

Australia

Mount Morgan, Ltd., Considers Smelter Plans

Concentrates now shipped to United States may be smelted in Australia—Mount Isa Mines plans increased recovery of lead and zinc

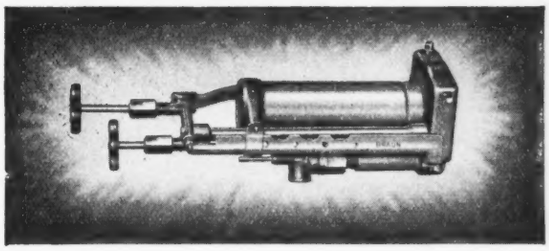
▶ The directors of Mount Morgan, Ltd., are reported to be considering the establishment of smelting works to treat the company's output of concentrates, which is at present shipped to U.S.A. for realization. A. F. McAskill, general manager, is soon leaving for America to study latest developments in copper smelting and also in open-cut mining methods, which it is intended to employ on a still larger scale at Mount Morgan. Production during the year to June 30 was 39,539 oz. gold and 1,806 tons copper. Of the gold 4,256 oz. came from the treatment of oxidized ore, which commenced in January. Net profit was £143,043, compared with £104,961 in the previous twelve months.

▶ Mount Isa Mines, Mount Isa, North Queensland, is installing a middlings regrinding unit for treating intermediate products of both lead and zinc circuits. It is expected that thereby mill recoveries of lead and silver will be increased by 3 per cent and of zinc by 5 per cent.

▶ Crushing operations at the Big Bell Mine, 22 miles from Cue, W.A., have begun. At present dump ore only is being treated and full-scale operation has not yet been commenced.

▶ Guadalcanal Dredging & Sluicing Company has been registered, with a nominal capital of £200,000, to develop alluvial areas in the Solomon Islands. The issue has been underwritten by a London group. The area is reported to contain 20,000,000 cu.yd. Preliminary testing is reported to have proved most satisfactory, but values have not been disclosed.

▶ The first run on the new 20-head battery of Central Nell Gwynne, Bendigo, was successful, 950 tons of ore being



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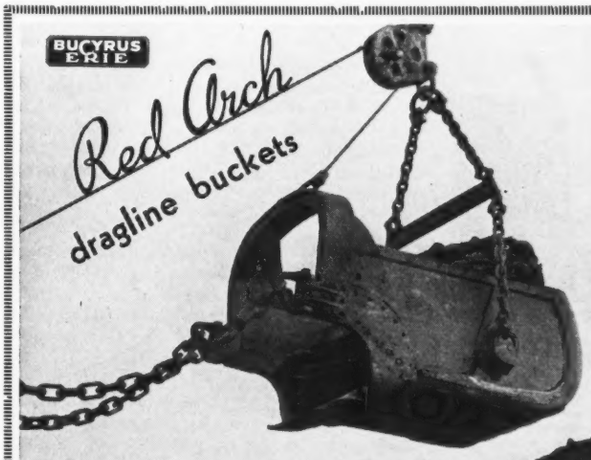

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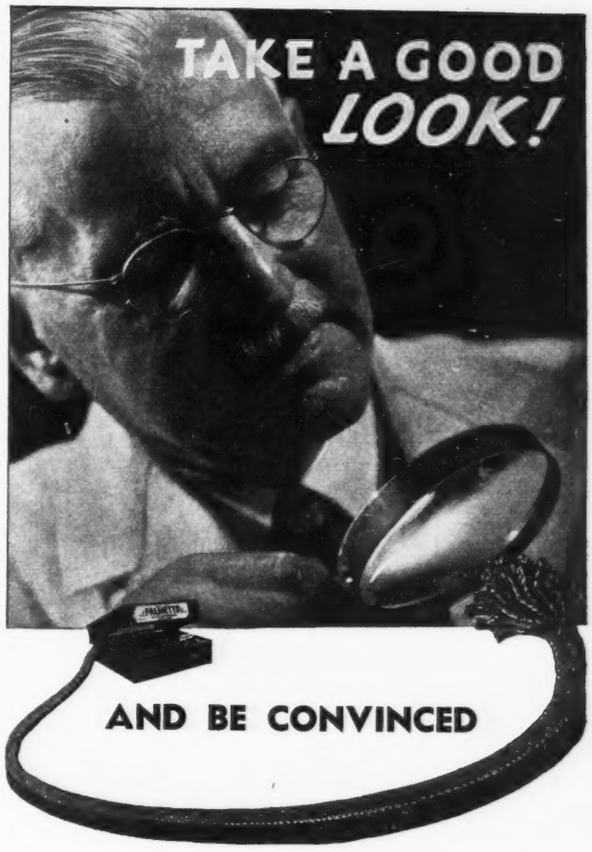

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put through for a recovery of 255 oz., averaging 5.3 dwt. per ton. Most of the ore treated was from the 870-ft. level, where the cap of a large reef is being stoped. Large reserves of ore have been developed on the 820, 870, and 920 ft. levels and developments continue to be satisfactory.

▶Redbank Dredging, N.L., which has been testing an alluvial area at Redbank, in the Avoca district, Victoria, has placed an order for a dredge of 100,000-cu.yd. monthly capacity to work the property, which is estimated to contain about 13,000,000 cu.yd. of payable wash.

▶At Golden Plateau, Cracow, Queensland, the main shaft has been completed to the No. 3 level (444 ft.) and crosscuts commenced towards the oreshoots. In the west crosscut, making towards No. 2 shoot, a lode which had been previously encountered on No. 2 level was cut, average assays being 4 dwt. over a width of 15 ft. disclosed to date. This lode does not appear at the surface.

▶An encouraging development has occurred in the mine of Wattle Gully Extended, Chewton, Victoria, where in shaft sinking a reef formation carrying visible gold has been encountered at a depth of 350 ft. Shaft sinking is being continued to intercept the main Wattle Gully lode, which is being worked profitably in the Wattle Gully mine to the north.

Africa

Roan Antelope Will Convey Ore on Belts 7,500 Ft.

Transport will be between mill and Storke shaft, which nears completion—Rhodesia's mineral production greatest in many years

▶Roan Antelope's annual report shows that 69,560 long tons of blister copper was produced last year (to June 30, 1937) at a gross cost of £25.496 per ton, including interest and reserves for replacements and obsolescence, and sold for prices averaging £51.022 per ton. Net profit after all deductions was £1,790,308 (on a gross capital issue, after the debentures were retired, of £1,663,320). After setting aside the amount required to pay the final dividend of 2s. 6d. per share, Roan closed the year with £1,394,404 net surplus of cash and quick assets. The increased cost of Roan Antelope's copper last year was due chiefly to higher royalties and selling expenses, these resulting from the higher price of copper, to the provision for a mine pension and benefit fund, and an increase of about 3d. per ton of ore in the cost of mining. Milling and smelting costs were reduced. Frank Ayer, general manager, states in his summary of the year's operations that the remaining proved ore reserves amount to 91,769,128 short tons averaging 3.43 per cent copper. The headframe of the Storke shaft is completed. This shaft, which will bottom at 2,645 ft., had reached a depth of 2,143 ft. and will be completed before the end of the year, having a capacity to hoist 18,000 tons of ore daily. It has been decided to transport the ore from this shaft to the mill, a distance of 7,500 ft., by large conveyor belts. (Largest belt conveyor system in the world conveys coal 4 miles at the Frick mine, in Pennsylvania.) The main drive on the north limb of the Roan syncline is now proceeding in ore which was not included in ore reserves.

▶Rhodesian Selection Trust has declared a dividend of 6d. per share. This follows an initial payment of 3s. a share by Mufulira Copper Mines. One interesting feature of these payments is that they bring all three of the Northern Rhodesia copper producers and the two holding companies—Rhodesian Selection Trust and Rhodesian Anglo American—into the list of dividend payers. The Mufulira dividend is 15 per cent on the £2,988,874 to which its capital was increased last May by the bonus issue of five £1 shares for each one held. All the capital of this company is held by Rhodesian Selection Trust, Rhokana Corporation, and British South Africa companies in the proportions of 64.07 per cent, 32.30 per cent, and 3.63 per cent, respectively.

▶Operations at the Rhodesia Broken Hill mine, in Northern Rhodesia, are followed with great interest. Technical circles estimate that within a few years this mine may probably become the largest producer of zinc, lead, and vanadium in the British Empire. Good progress has been made in the last few months. Nine boreholes were sunk to locate a suitable site for a new pumping shaft, and the last hole, which gave practically 100 per cent core recovery, was in dolomite free of cavities or fissures. Sinking at this point has commenced and the shaft is expected to be finished in reasonable time.

A drilling program is under way to determine the ore deposit in depth. This offers difficulty in view of the irregular shape of the orebody. However, borehole A 123 from a depth of 1,031 to 1,093 ft. recently penetrated ore which has been identified as the continuation of a previously recognized orebody. The ore at this point was still oxidized, but it contained a section of sulphide ore 3½ ft. wide, which averaged 25 per cent zinc and 39 per cent lead. The oxidized ore from 1,045 to 1,065 ft. also contained no less than 3.5 per cent vanadium. Although the company's output of electrolytic zinc had to be curtailed, owing to water shortage, satisfactory profits have been made. Arrangements have been made to augment the hydro-electric power supply by steam-driven units so as to have the necessary power available for the additional pumping load when the pumping shaft is completed. With the beginning of the rainy season the hydro-electric unit will again permit the production of electrolytic zinc. The mine manager, Mr. Pickard, is now on holiday in the United States.

▶"The Southern Rhodesian Economic and Statistical Bulletin" recently reported mineral production for the first seven months of the year. Total value of mineral production during this period was £4,291,182, compared with £4,111,103 in the corresponding period last year. The following are the detailed figures, comparative figures for the same period last year given in parantheses: Gold, £4,271,595 (£3,284,352); asbestos, 33,034 tons (32,386); crome, 165,274 tons (109,011); iron pyrites, 12,546 tons (9,708). The value of other minerals and metals in the first seven months of this year was £46,653, against £21,912 in the corresponding period of last year. Sundry producers in the Marico district produced 66.5 tons of lead concentrate containing 79.4 per cent lead.

JAPANESE INTERESTS BUY MINES IN KOREA

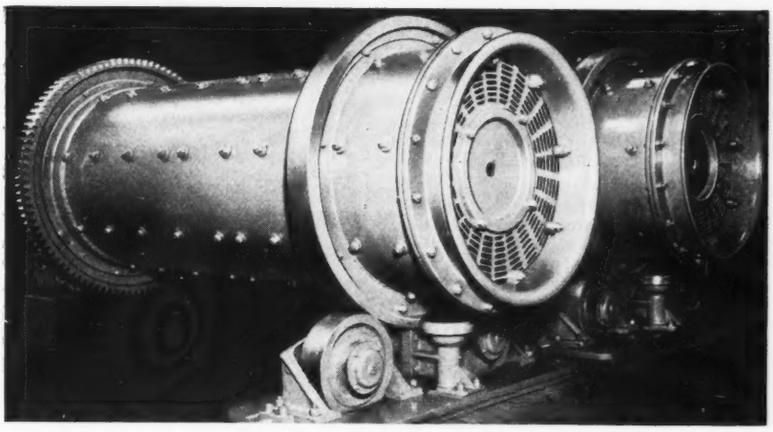
CHOSEN CORPORATION has been notified by cable from Japan that the assets and properties of its two subsidiaries, the Nurupi and the Kapam companies, have been sold to the Japan Mining Company for a price which the directors are said to consider satisfactory. No details are yet available, but it has been intimated that the price was between £700,000 and £800,000. As Chosen has 725,000 shares of £1 par, of which 150,000 are only 4s. paid, the price unofficially reported would be approximately equal to its issued capital. There are, however, suggestions that the sale was of a complicated character, which may mean that it was effected under pressure, as Japan is said to have been actuated by a desire to have its natural resources in the control of its own people. The Norupi ore averages 7.39 dwt. gold per ton and is treated in a mill of 500 tons' daily capacity.

ONE REPORT states that following the signing of the final sale agreement the Bank of Japan immediately raised its buying price for gold from 112s. to 126s. Serge Rubinstein, managing director of Chosen, is reported to have left Tokyo for London.

▶Rio Tinto Company paid the regular half-year dividend of 2½ per cent on its preference shares Nov. 1. The income which permits of this is from its large holdings of Rhokana Corporation, the war in Spain having rendered its Spanish properties relatively unprofitable.

EQUIPMENT NEWS

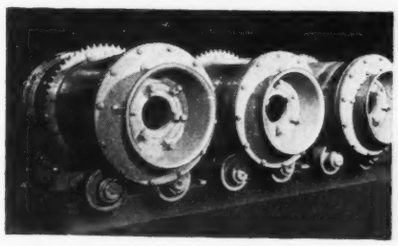
New Grinding Mills



STRAUB MANUFACTURING INC., 567 Chestnut St., Oakland, Calif., announces the recent manufacture of special grinding mills for chain drive, and mills for use where sliming is not desirable.

The larger photo illustrates two special regrinding mills arranged to give a grid discharge the full diameter of the inside of the mill.

These machines are said to have been required for work where no over-grinding or sliming of the gold was permissible. The barrel consists of heavy steel plates with cast-steel heads. The feed end of the mill is supported in a large diameter, babbitted bearing of the spherical seated type and fitted with a drum type of feeder. When required, combination drum and scoop feeders or standard scoop feeders can be supplied. The discharge end of the mill is supported on a renewable forged-steel tire resting on steel supports wheels. These wheels are mounted on anti-friction bearings, steel housing, and are furnished with steel supporting brackets and steel sole plates. Vertical-thrust rollers mounted on anti-friction bearings are said to be fitted to each side of the driving tire so as to take care of severe end-thrust commonly experienced on gold dredges. The two mills shown are finished with rubber liners, but liners of manganese steel or other material can be furnished. The large diameter of the discharge grid and the absence of any pocket or trap within the grinding section are said to insure rapid delivery of all gold-bearing particles without sliming. The central portion of the grid is removable and serves as a man hole for inspection. These mills are said to permit arrangement in the flow-sheet of a dredge to receive the products from gold jigs and followed by a bank of amalgamation plates receiving pulp directly from the mill.



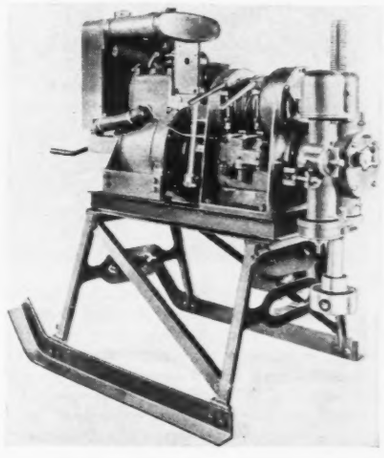
The smaller photograph illustrates three special mills arranged for chain drive designed to occupy the minimum amount of space. They are said to be practically self-contained units, as each mill is furnished with a heavy steel sole plate on which are mounted the supporting wheels furnished with anti-friction bearings, said to be completely inclosed against dust or water. These mills are said to give a light grinding action and a polishing or grinding effect to placer sand and concentrates, although they can be used for general grinding or re-grinding work. They are also arranged for inside amalgamation, as the barrel of the mill consists of a solid and heavy combination shell liner of wear-resistence steel. The feed is by means of a drum feeder, bolted directly against the feed head, thus making the mill short and compact. A feature is the adjustable diaphragm discharge head. If made in this manner one or more rings can be readily removed, thus altering the height of the pulp level within the grinding chamber. This is said to permit a definite amount of grinding, polishing, or amalgamation to material flowing through the mill. If desired, the central opening can be covered by a grid or coarse screen. The mills are driven by means of a machine-cut sprocket made in two pieces and bolted to a flange around the center of the grinding barrel. These mills can be furnished in belt drive or with gear and pinion drive.

Starter for Mining Duty

TO MEET THE NEEDS of the mining industry, the General Electric Company, Schenectady, N. Y., has brought out the CR4061-C1B heavy-duty, direct-current starter. The new unit is a compact, long-life device which provides two-point acceleration for constant-speed motors, shunt or compound wound, rated 1 to 20 hp., up to 600 volts. Some of the features included in this starter are thermal and instantaneous overload protection, externally operated line switch capable of interrupting load, field-adjustment rheostat to compensate for line variations, and correct operation on line fluctuations of 150/300 or 325/600 volts. Since power is supplied by cable in most mines, the line voltage usually varies considerably. As it is essential that practically constant speed be held on most mine drives, a field-adjustment rheostat is provided on this starter to compensate for small voltage variations. The starter mechanism is protected from dust, moisture, and corrosion by a non-ventilated, cadmium-plated inclosing case.

Light Weight Gas-Driven Core Drill

THE NEW GAS-DRIVEN Pioneer Straitline manufactured by E. J. Longyear Company, Minneapolis, Minn., is said to meet the requirement for modern core drilling in remote places, as it can be dismantled into small units, the heaviest of which weighs 310 lbs., and transported by pack horses or airplane. The two-cylinder gas engine will develop 6.7 hp. at 1,800 r.p.m., and the capacity rating is 600 ft., recovering core ⅞ in. in diameter. In favorable formations this depth may be increased. Ample power is said to be delivered by means of the Straitline principle from the motive unit through



a clutch and transmission to the bit. This eliminates chains or belts and is said to result in smooth, steady rotation with a consequent increase in drilling progress and a saving in carbon or bortz wear. The swivel head is fully inclosed and is said to be equipped with a safety chuck. Standard gears give bit rotating speeds of 264, 420, and 820 per minute, and with fast gears speeds of 376, 680, and 1,170 are attained. Pioneer Straitline may be equipped with either gas, air, or electric motor. The entire outfit is compactly mounted on a structural steel frame.

Gas Scrubber for Diesel Mine Locomotive

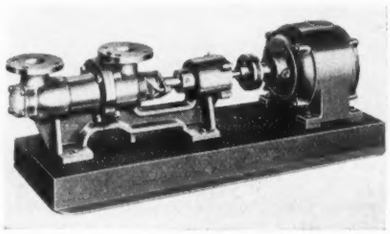
TO REDUCE THE TEMPERATURE of the diesel exhaust on its underground locomotive, the Ruth Company, Denver, Colo., has devised a scrubber. It consists of a water-saturated medium so designed as to afford maximum diffusion of the exhaust gases and minimum back pressure on the engine. The temperature of the engine exhaust is roughly 800 to 900 deg. F., which is reported to be reduced to 140 deg. F. by the scrubber. About one quart of distilled water is required for eight hours' operation.

Belt Conveyor Carrier

STEPHENS-ADAMSON Manufacturing Company of Aurora, Ill., announces a new lightweight ball-bearing belt conveyor carrier. The lightweight, rigid truss-type frame is said to be supported on two parallel pipes instead of the conventional structural steel or bulky timber stringers. Carrier brackets are clamped to the pipes without boring holes and carriers can be shifted whenever necessary. By using standard piping, a light, sturdy conveyor frame can be quickly and inexpensively assembled from materials obtainable anywhere. An ingenious rocker type of mounting is said to permit the carrier to tilt in either direction with the travel of the belt. In this way, even a reversible direction belt is centered on the carriers without the use of guide rollers. Permanently sealed cartridge type ball bearings are used to increase bearing life and reduce maintenance costs.

Rotor and Stator Valveless Pump

ROBBINS & MYERS, Inc., Springfield, Ohio, announce the offering of the Moineau (Moyno) pumps, as exclusive licensees on this continent. The Moineau (Moyno) pump is said to be capable of handling practically any liquid which will flow through a pipe. Its application is said to be limited only by the choice of materials used in its construction. The correct choice of materials rests on two considerations: First, that these materials will not be attacked by the liquid flow through the



pump; second, that this liquid shall serve as a film between the two materials used for the rotor and stator respectively. This pump combines the many advantages of piston, centrifugal, gear, and screw pumps, but eliminates many of their undesirable characteristics. Since it is positive in displacement, and there are practically no working clearances, and no suction or discharge valves to lift, it is said to be self-priming to within 1½ in. mercury gage of barometer.

The pumping elements consist of one stationary part, called the stator, and one rotating part, the rotor assembly. The stator is in the form of a cylindrical lining which has an internal form of double-threaded helix.

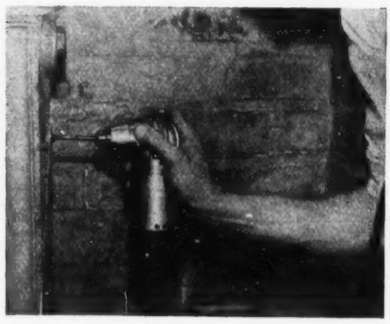
The rotor, on the other hand, is in the form of a single threaded helix, such that it meshes with, and turns in, the helix of the stator. Thus, it effects a positive endwise displacement of the liquid in remaining space of the open helix. The result is that the rotor maintains a sealed contact throughout its length, and the pump is valveless. Erosion problems are said not to occur owing to the much lower relative velocity of flow of liquid and grit over the surfaces of the pumping elements. Pump sizes are from 2 in. to 10 in. single stage. The 10 in. size will deliver 139 g.p.m. at 200 ft. head.

Wagon Drill

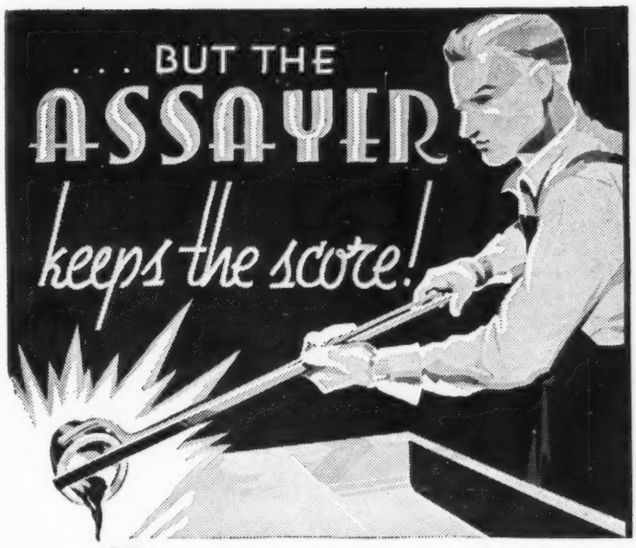
INGERSOLL-RAND Company, 11 Broadway, New York City, announces its New FM-2 light-weight wagon drill, featuring a ratchet, by means of which one man can quickly raise or lower the drill guide on the uprights. This drill is said to have the same automatic, positive feed at any angle which proved successful on the previous model. This air-motor controlled-pressure feed is said to provide an infinite range of feed pressures from 1 to 1,000 lbs., and a worm gear, which transmits power from the air motor to the feed chain, is self-locking, said to eliminate all thrust and shock to the motor, and preventing the drill from dropping or jumping forward. The wagon mounting uses the same type drills as the larger wagon drills and will accommodate a 6-ft. steel change. Twenty-foot steels are said to be easily handled. The FM-2 is built for continuous, heavy-duty operation, yet it is light and said to have the versatility of a Jackhamer.

Small Drill

A SMALL NEW UNIT, said to present an entirely new principle of electric-drill construction. is announcel by Black & Decker Company, Towson, Md., The drill, known as "Shorty," is said to meet many drilling requirements with a new idea in drill design. The



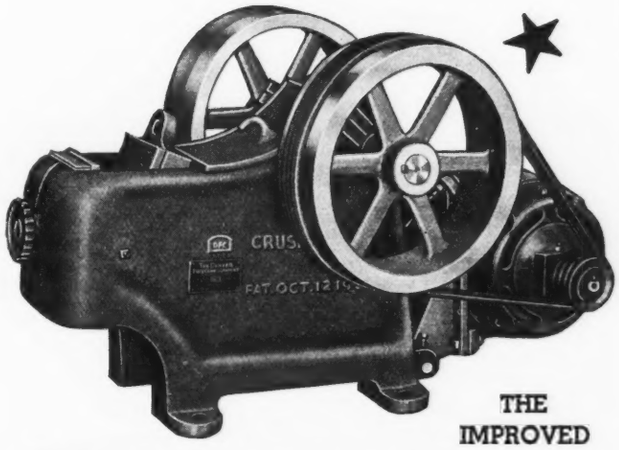
THE 33-B, A 1¼-YD. EXCAVATOR convertible for shovel, dragline, clamshell, crane, or dragshovel service has recently been announced by the Bucyrus-Erie Company, South Milwaukee, Wis. Modern alloy steels and welded construction are said to have been used to produce a machine that combines smooth working operation, high speed, high mobility, and ample strength to give steady, dependable service in the heavy digging expected of a machine of this size. Used as a dragline this machine is said to be suited for placer mining work such as excavating gold bearing gravel from lake and stream beds and loading to doodlebugs and hoppers.



MEN and money and machines are just the players in the "game" of mining. THE SCORE IS KEPT BY THE ASSAY OFFICE—where one of the industry's most responsible men determines just how much precious metal is being produced.

For strictly accurate score-keeping, insist on . . .

DFC Assay Equipment and Supplies



THE IMPROVED

DFC Laboratory Crusher

. . . Motor pivoted from frame for correct belt tension always. Reversible jaws for double life. One-piece, rugged frame. Easy adjustment for size. Easily cleaned. BUILT TO STAND UP.

WRITE FOR CATALOG 13

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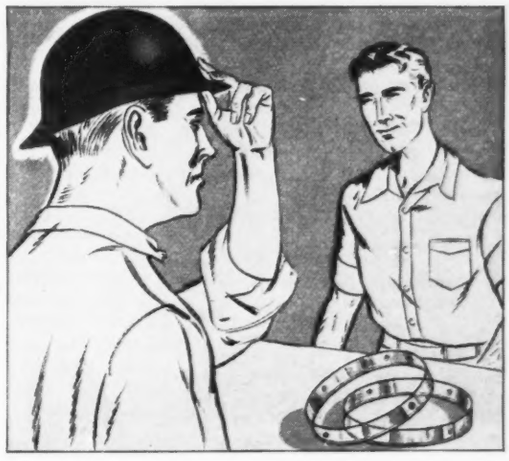

That's the *Tuff-Nut* way of stock keeping

Yes sir! We mean just that. You can keep a complete stock of Tuff-Nuts in all usual sizes for HALF your present investment in hats, or less!

Your man comes in for a Tuff-Nut. You fit him with a sweatband of his exact size. You then select the proper Tuff-Nut crown from one of the three groups (large, medium or small). Snap in the band in exactly 4 seconds, and he's off, with perfect head protection.

One crown for three sizes of head bands means a minimum stock savings to you of at least half, perhaps more. That's the Tuff-Nut way of keeping stock.

The Tuff-Nut is the lightest weight hat on the market.

It is ventilated by air space that runs completely around the head.

Its "lifetime" plastic band does not absorb dirt or perspiration.

And besides all these, the Tuff-Nut offers six additional features for greater comfort, better protection and more economy. The new Tuff-Nut circular describes them all. Send for it today.

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chuck spindle is mounted at right angles to the motor and reduces the overall working length of the tool to 4½ in. Motor housing dimensions have also been reduced to a minimum so that the tool fits snugly in the operator's hand, and requires no extra handle. An ingenious ventilating arrangement is said to assure cool motor operation. Deep vents cast in the gear-head provide for free passage of air, even though the tool is grasped by the head. The tapered end of the gear-head extends over the chuck, protecting operator's fingers. The unit is ball-bearing equipped throughout and has a universal motor which operates a. c. or d. c. A removable insulated cap provides easy access to brushes for inspection.

Water-Proof Flashlight

STEWART R. BROWNE Manufacturing Company, Inc., New York, N. Y., has designed a new type of flashlight. The entire case is constructed of high-impact resistant Bakelite, molded, and the lens is said to be of shatterproof glass. The light is so constructed that it can be used under water or other fluids, for indefinite periods—being water-tight and also gas-tight. There are no parts that will corrode, as the hermetically sealed switch is said to be inclosed in the rotating knob at the flashlight's base. This rotating base controls both the light connection and the focusing mechanism. The company states that the light can be operated in mines, oil wells, or wherever there is danger of gas explosion.

Long Range Dragline

HARNISCHFEGER Corporation, of Milwaukee, presents the P&H Model 955-LC Dragline—as a modern 2½-yd. machine to give bigger production on all classes of dragline work. Following the type of all-welded design used in other P&H excavators, the 955-LC has been stripped of dead weight—making it lighter, faster, and easier to move. The 80- to 100-ft. aluminum boom is said to permit a wider working range. This model is said to be provided with exceptionally long crawlers, accommodating shoes 30, 36, or 42 in. wide. Crawlers are of non-clogging type, have a true rolling action in travel, and are easy to adjust. The large-diameter sheaves are said to be light in weight, and roll free and easy, and the cable wear is said to be reduced to a minimum. Alloy steel sections are welded together to form a rigid upper revolving frame that is reported to have the strength to stand up under severe loads typical in dragline operation and to keep machinery from pulling out of line. The entire upper structure is machined as a unit after welding to insure perfect alignment of all working parts.

The model is powered by a 185-hp. eight-cylinder diesel engine. Other features of the Model 955-LC include helical gear drive throughout, roller bearing mounted drums, clutches, and shafts, and big live roller circle that supports the revolving upper and is tied to the lower car-body by the use of hook rollers to insure perfect balance on long boom operations.

INDUSTRIAL NOTES

Equipment Exposition—The sixteenth Exposition of Chemical Industries will be held in Grand Central Palace, New York City, during the week of Dec. 6, 1937. Although organized primarily for the chemical industries, the exposition will hold considerable interest for metallurgists engaged in the treatment of ores and minerals. Much of the equipment on display will be pertinent to ore metallurgy, particularly pumps, valves, screens, conveyors, classifiers, thickeners, dust collectors, crushers, and filters. Among other items of common interest to metallurgical and chemical engineers are instruments for recording and controlling temperature and flow of fluids, the latest developments in which will be on display.

Oliver United Filters, Inc., New York, Chicago, and San Francisco, announces the appointment of E. Corning Faber to its sales engineering staff.

Denver Fire Clay Company recently moved into new general offices and sales headquarters, to 2301 Blake St., Denver, Colo.

Hyman Michaels Company announces the removal of its general offices from the 20 North Wacker Drive Building to Suite 1825, 122 South Michigan Ave., Chicago (Peoples Gas Building).

The Lincoln Electric Company, manufacturers of arc welding equipment, Cleveland, Ohio, announces the opening of a new sales office in Phoenix, Ariz., which will be in charge of R. J. Reardon.

BULLETINS

Brazing Alloy. Handy & Harman, 82 Fulton St., New York, N. Y. Folder describes brazing alloy for ferrous and nonferrous metals and chrome-nickel and copper-nickel alloys. P. 9.

V-Belts. Rockwood Manufacturing Co., Indianapolis, Ind. Catalog 795 covers applications for the manufacturer's single-groove V-belts. P. 30.

Dredge Bucket Lip. Hadfields, Ltd., Sheffield, England. Folder describes renewable rivetless lip for dredges. P. 4.

Carbide Lantern. National Carbide Corporation, 6 East 42d St., New York, N. Y. Folder illustrates and describes new NG-1 carbide lantern.

Non-Metallic Cable. Anaconda Wire & Cable Co., 25 Broadway, New York, N. Y. Bulletin C-27 describes non-metallic sheathed cable for direct burial in the ground and lists data on application, installation, and engineering. P. 20.

Impact Mill. Raymond Pulverizer Division, Combustion Engineering Co., Inc., 1315 North Branch St., Chicago, Ill. Bulletin 31 describes the Imp mill and its application for disintegrating concentrate and other materials. P. 7.

Oxygen Apparatus. Mine Safety Appliances Co., Pittsburgh, Pa. Bulletin describes and illustrates the McCaa two-hour oxygen breathing apparatus. P. 4.

Belt Conveyors. Chain Belt Co., 1600 West Bruce St., Milwaukee, Wis. Catalog 270 is a loose-leaf ring binder book containing useful data for the belt conveyor user and the designing engineer. The catalog is well illustrated and contains numerous tables and charts for convenient selection of units for various material-handling plant designs. P. 114.

Fan Control. Mercoid Corporation, 4201 Belmont Ave., Chicago, Ill. Bulletin M-12 describes the manufacturer's combination fan and limit control for warm air furnaces. P. 4. **Automatic Controls.** A loose-leaf brochure describing the various control units made by the company. P. 14.

Alloys and Overlay Metals. Colmonoy, Inc., Los Nietos, Calif. A general catalog No. 60 lists overlay products applied to surfaces of metals against corrosion. P. 15.

Diesel Engines. Western Engine Corporation, 1000 Alhambra Ave., Los Angeles, Calif. Booklet describes manufacturer's Type DS six-cylinder diesel engine to meet demand for moderate-speed engines. P. 7.

Washing Thickener. The Dorr Co., Inc., 570 Lexington Ave., New York, N. Y. Bulletin 3071 describes the special type of Dorr tray thickener for performing up to five separate stages of counter current washing in a single compact unit. P. 9. **Turret-Bowl Classifier,** Leaflet 2251 describes features of Type F and FX turret-bowl classifier, P. 2.

Hub Sprockets. Baldwin-Duckworth Chain Corporation, Springfield, Mass. Bulletin 60 lists dimensions and prices of standard hub sprockets made by the company. P. 24.

Packings. Metalastic Manufacturing Corporation. Hackensack, N. J. Calatog describes various types of packing material for industrial purposes. P. 16.

Filters. Oliver United Filters, 22 West 42d St., New York, N. Y. Bulletin 206 describes and illustrates the latest features of the Oliver continuous, the precoat, American continuous, and Dorrco filters, and the Oliver-Bordon tube thickener. P. 15.

Calyx Drill. Ingersoll-Rand Co., Phillipsburg, N. J. Bulletin 2213 describes and illustrates the calyx drill for use in exploratory work. P. 4.

Neoprene. E. I. du Pont de Nemours Co., Wilmington, Del. Booklet describes an engineering material with rubber-like properties for various uses in industry. Of special interest is a summary of the method of making Neoprene, formerly known as Duprene. P. 22.

Jackhamer. Ingersoll-Rand Co., Phillipsburg, N. J. Folder describes features of the new JA-55 Jackhamer. P. 4.

Refractory Cement. Refractory & Insulation Corp., 381 Fourth Ave., New York, N. Y. Bulletin R-31 describes the application of R & I No. 3000 refractory cement used in industrial and domestic furnaces and high-temperature processing equipment. P. 4.

Clamshell Bucket. Hayward Co., 50 Church St., New York, N. Y. Bulletin 670 describes features of clamshell bucket known as "Class E-15." P. 5.

Fire-Tube Boiler. Combustion Engineering Co., Inc., 200 Madison Ave., New York, N. Y. Catalog N-5 describes and illustrates the principle of controlled circulation in the manufacturer's specially designed fire-tube boiler. P. 16.

Engineering Properties of "K" Monel. Development and Research Division, The International Nickel Co., Inc. 67 Wall St., New York, N. Y. Bulletin T9 describes features and uses of "K" Monel. **Nickel Cast Iron Data,** Section 3. No. 7, describes heat treatment fundamentals of nickel cast iron. P. 15.

Oil Blast Circuit Breaker. General Electric Co., Schenectady, N. Y. Bulletin GEA-2406A describes construction features of Type FKO-227 outdoor oil-blast circuit breakers. P. 4. **Switchgear.** Bulletin GEA-2605 describes and illustrates various types of switchgear equipment. P. 8.

Turbine Pumps. Roots-Connersville Blower Corp., Connersville, Ind. Bulletin 260-B11C describes and illustrates types of construction of Type "T" pumps for industrial uses. P. 5.

Pumps. Peerless Pump Division, 1900 East 67th St., Los Angeles, Calif. Catalog P-127 is a loose-leaf brochure, handsomely illustrated in color, describing features of the various pump designs and containing a section of useful engineering and hydraulic data. A feature of the catalog is a series of printed maps illustrating full and sectional views of various pump designs. P. 64.

Drilling With Detachable Bits

The Investigation Is Continued at Some Western Mines

THIS PAPER presents comparative statistics and costs on drilling at eight mines not reviewed in previous reports, comparison of the use of detachable bits at small mines and large mines, a discussion on the life of drill rods, and general conclusions derived from an analysis of the rock-drilling practice at all the mines investigated on this survey. It completes the descriptions of operating practice in rock drilling at individual mines. Data on drilling practices and drilling costs at 28 mines will be given in appendices.

Research in the fundamentals of rock drilling, including the use of detachable bits, has been undertaken by the Bureau of Mines in its testing adit at Mount Weather, Va. Reports will be issued when results warrant.

As in previous reports, costs and other data at the individual mines investigated were developed by the operators, except as noted. Assistance and cooperation of the officials and staff members at the mines visited are gratefully acknowledged.

General Conclusions Derived From Analysis of Data Developed by 28 Metal Mines—Rock-drilling practice, including the use of detachable bits, is an individual problem at each particular mine. Since the process of drilling comprises many subdivisions, each with wide variations from one property and one district to another, it is difficult to establish a fixed universal standard for this work. The true basis of comparison between the detachable bit and the conventional bit is the total cost per foot of hole drilled at the mine under consideration.

Success or failure of detachable bits at a given property depends not only on the comparative service of the bits but also upon the quality of the fabricated rods or shanks to which the bits are attached. Since in general, at this date, the development of rods has not kept pace with improvement in the manufacture of detachable bits, the service of a rod at present hinges principally upon its treatment during fabrication in the conversion shop. Thus, improper shop methods in making up rods might cause an adverse decision on the adoption of detachable bits, even though their drilling performance were favorable in all other ways.

Although it is difficult to avoid personal prejudice in research and to form unbiased conclusions, an honest desire to determine the facts, with due consideration of all the items affecting the total cost of drilling, will do much to eliminate conflicting information concerning the use of detachable bits.

An empirical index for the use of detachable bits in metal mines has been derived from an analysis of drilling practice at those metal mines throughout the United States where comparative data were known to be available. This does not apply to small contracts for rock excavation but pertains to routine metal-mining operations. The index is based on the life of a detachable bit in terms of feet drilled from its initial use until its final discard. In other words, the life is the sum of the distances drilled on all its uses, including those after each reconditioning; it is the total feet drilled per bit purchased. Although the life of a detachable bit is not a simple function of any single quality of the rock drilled, nor of any one characteristic of drilling equipment, its principal factor is the abrasiveness of the rock drilled.

Under present conditions at the metal mines included in this survey, if the life of a detachable bit is in excess of 10 ft., its use is almost certain to prove more advantageous than that of the conventional bit on regular steel, provided the diameter of the drill hole in normal use lies within the range of detachable bits. If the life is less than 4 ft., there is little prospect that detachable bits will prove economical.

This 4-ft. limit is one of the curious things discovered from comparison of data from all the mines studies. Although empirical, it may be that under these conditions the depreciation charge on detachable bits exceeds transportation and forging costs for conventional bits. If the life lies in the zone between 4 and 10 ft., usually there must be some special condition to warrant the adoption of detachable bits. If this special condition does not occur throughout the entire mine, the use of detachable bits may be limited to certain sections or to specific operations where the favorable circumstances do apply.

Comparison of rock-drilling practice with conventional and detachable bits at eight individual metal mines is presented. Where costs and data on drilling performance were available, they are also included.

Excerpted from "Progress Report No. 4 on Investigation of Detachable Rock Drills," by McHenry Mosier, published by The Bureau of Mines as Information Circular 6951. The preceding three reports on the subject, likewise by Mr. Mosier, are respectively Information Circulars 6877, 6911, and 6936, published in 1936 and 1937.

Western Mine No. 1

Summary—At this mine detachable bits are becoming standard for all drilling. The only conventional bits now in service are those used with hand-rotated stopers, which are being replaced gradually by self-rotated machines. A marked decrease is shown in the total cost per foot drilled with detachable bits. Use of detachable bits has reduced the amount of time lost by miners in transporting drill steel and has increased the time available for drilling at the face. Detachable bits have increased the drilling speed.

Rocks Drilled—The rocks drilled at this mine are metamorphosed sediments into which have been intruded diabase and porphyry. All of these rocks, including the ore areas, have been considerably silicified. The ground, although variable in hardness, is considered to be good for drilling.

Operating Practice—The drills in use are 2¼-in. and 2⅝-in. jackhammers, 2¼-in. and 2¾-in. hand-rotated stopers, 2⅝-in. and 3-in. automatic rotated stopers, and 3½-in. drifters. A few of the drifters are equipped with automatic feed. There is one operator per drill. Air pressure at the compressor is 90 to 95 lb. per square inch and at the drill it is 80 lb. minimum. Average depth of holes is 5 ft. in development headings and 12 ft. in the undercutting in stopes. Jackhammers have a penetration of about 6 in. per minute; 3½-in. drifters have 12 in. and 4-in. drifters, 15 in. per minute. The effective drilling time is 4 hours per machine-shift.

Regular Steel With Conventional Bits—Conventional bits are the standard cross type with 90 deg. between cutting faces and with double clearance tapers of 5 and 14 deg. The carbon content of the steel is 0.85 per cent.

The sharpening shop, which is at the collar of the shaft, has the following equipment: 3 machine sharpeners (2 are now spares), 3 punches (2 are now spares), 4 single-opening oil furnaces that use high-pressure air, 1 pyrometer on furnace for quenching heat, 2 forges and anvils, 1 water quenching tank, 1 oil quench-

ing tank (water-jacketed by being placed inside a larger tank), and 1 air hammer.

The incoming dull steel is sorted by lengths and placed in suitable racks. At present, 50 pieces of steel with conventional bits are sharpened per day. The routine for forging and hardening, which follows accepted standards, includes the treatment of the hot bits with powdered cyanide. A

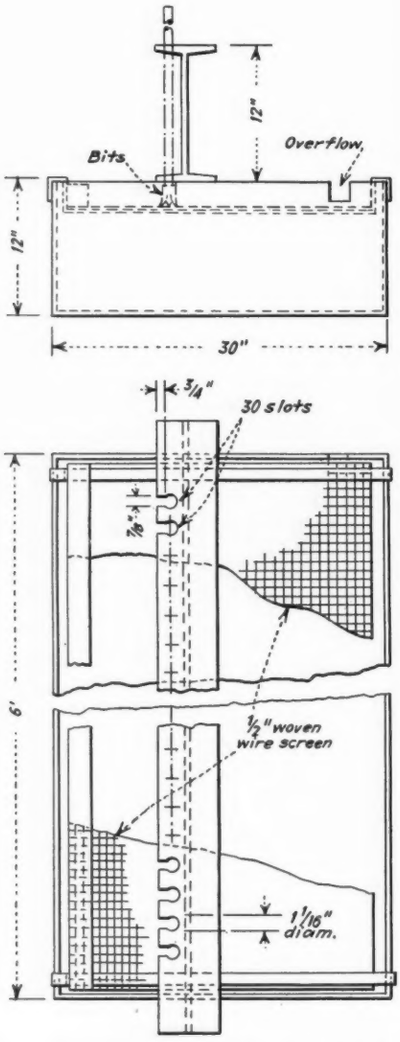

Fig. 1 . . . QUENCHING TROUGH for detachable bits after grinding and heating

5-lb. can of cyanide, costing $2.25, will treat 2,000 bits. The life of a bit is thus increased approximately 30 per cent. Before detachable bits were introduced, one operator and his helper sharpened 425 pieces of steel per shift.

Reconditioning conventional steel at this mine follows a six-day cycle. In other words, it requires six days for a given piece of steel, after leaving the sharpening shop, to be transported to the underground magazine and to the working face, and then, after it is used, to be returned to the magazine, transported to the sharpening shop, and resharpened. In this six-day cycle, the effective drilling time for an individual bit is approximately two minutes.

Detachable Bits—The only new equipment added to the shop to recondition detachable bits was one bit-grinding machine. Three sections of steel are used in making up rods, as follows: 1¼-in. hollow round for drifters; ⅞-in. hollow quarter octagon for stopers; and ⅞-in. hollow hexagon for jackhammers.

The detachable bits are mostly the four-point or standard cross-bit pattern, although there are a few six-point or rose-bit pattern. Although it is thought that the latter type has some advantages, no definite conclusions have been reached regarding the standard for the mine. All bits have a central water hole.

All new bits purchased for 1¼-in. steel are 2⅛ in. in diameter; those for ⅞-in. steel are 2 in. in diameter. Bits are ground to standard ⅛-in. gage changes. With 1¼-in. steel the finisher has a 1⅝-in. gage, and with ⅞-in. steel it has a 1½-in. gage.

All dull bits returned from the mine are annealed before each regrinding. This is done by placing them in a furnace heated to about 1,800 deg. F. After the burner is turned off, the bits are left overnight to cool with the furnace. On the following morning these annealed bits are ready for grinding. One operator can grind 150 bits per shift.

Average life of a forming wheel is about 1,400 bits; that of a gaging wheel is 2,400 bits. The bits sharpened were mixed sizes and gages, about 75 per cent being for ⅞-in. rods and 25 per cent for 1¼-in. rods. The bevel angle on the forming wheel for cross bits is 60 deg. and for six-point bits is 50 deg. The life of the grinding wheels and the speed of cutting are increased by the use of a soluble cutting oil diluted with distilled water in the ratio of 1 part of oil to 60 parts of water. As an additional protection to the operators beyond that provided by wet grinding, the use of respirators while grinding is compulsory.

The bits are hardened after each regrind. They are screwed onto ⅞-in. drill-steel holders 22 to 25 in. long. After being heated in an oil furnace to about 1,500 deg. F. they are plunged into a rising current of cold water with a submergence of ½ in., or to the base of the wing. The quenching trough and the rack for supporting the bits and their holders are shown in Fig. 1. About 75 bits are hardened per hour by one operator, whose wage is $0.58½ per hour.

Bits average four regrinds, or five uses. With an average penetration of 8.92 ft., the life of the bit is 44.6 ft.

Two bit-carriers of the type illustrated in Fig. 2 are provided for each miner. These carriers have a capacity of 32 bits for use with ⅞-in. rods, or 20 bits for use with 1¼-in. rods. The miner receives sharp bits at an underground tool magazine, which is centrally located, and returns all his bits to the same place. Sharp bits are segregated by sizes and sacked for transportation from the surface shop to the underground magazines. Dull bits are returned from the magazines to the surface in the same manner.

Rods have been fabricated from an old stock of unused drill steel with 0.85 per cent carbon content. They are cut into lengths having differentials as follows: rods for drifters, 28 in.; for jackhammers, 24 in.; and for stopers, 18 in.

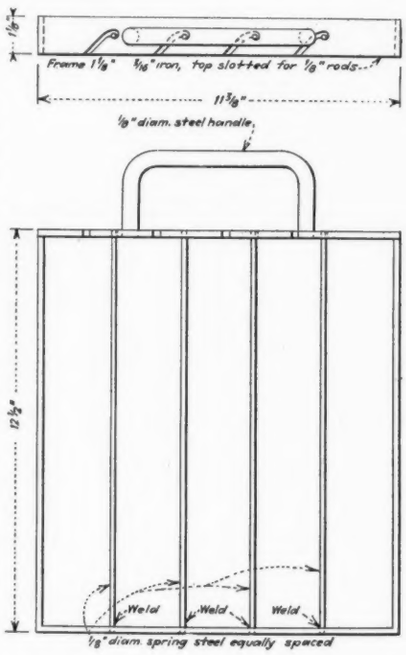

Fig. 2 . . . A CARRIER for detachable bits. Each miner has two

The thread end of 1¼-in. rods is given a forging heat of 1,800 deg. F. through a distance not exceeding 3 in. preparatory to upsetting. The rod is then normalized by heating to 1,600 deg. F. and cooling in the open atmosphere. Next, threads are rough-cut on a lathe at the mine machine shop. The threads are then finished with hand dies. One machinist can thread five rods per hour, or 40 rods per shift. The rod is again normalized by heating it slowly to 1,600 deg. F. and maintaining it at this temperature for 1 hour, then cooling in a dry place with no draft. The thread end of the rod is slowly brought to 1,540 deg. F., as indicated by a pyrometer, and held at this heat for 1 hour. There must be at least a 2-in. overlap on the forging heat. The thread end is quenched in oil until black, when it is withdrawn and cooled in the open atmosphere.

(To be continued)